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THE

JOURNAL

OF THE

BOMBAY NATURAL HISTORY SOCIETY

INDEX AND TITLE PAGE

VOL. 52

Nos. 1, 2 & 3, and 4

Price Rs. 5-0-0

MADRAS
PRINTED AT THE DIOCESAN PRESS
1958

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506.54
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1954-55

THE
JOURNAL
OF THE
BOMBAY NATURAL HISTORY SOCIETY

EDITED BY
SÁLIM ALI, and H. SANTAPAU, S.J.

VOL. 52

Nos. 1, 2 & 3, and 4
Containing 1 coloured, 59 black-and-white plates, 5
photographs in text, 5 maps, and 111 text figures

Dates of Publication

Part 1	(Pages 1 to 232)	... April 1954
Parts 2 & 3	(Pages 233 to 686)	... August-December 1954
Part 4	(Pages 687 to 962)	... April 1955

AGENTS IN ENGLAND
WHELDON & WESLEY LTD.,
Lytton Lodge, Codicote, Nr. Hitchin,
Herts, England

PRINTED AT THE DIOCESAN PRESS, MADRAS
1958

ERRATA

Vol. 52, Nos. 2 & 3, page 519, in the fifteenth line from top in place of types fallen off, please read '70. **Nerium indicum.**'

Vol. 52, No. 4, Plate I (coloured) facing page 687, please read 'The Chestnut Bittern (*Ixobrychus cinnamomeus*)' in place of the printed caption 'The Yellow Bittern (*Ixobrychus sinensis*)'.

CONTENTS OF VOLUME 52

No. 1

PAGE

WILD LIFE PRESERVATION—KRUGER NATIONAL PARK, AN EXAMPLE. By A. St. J. Macdonald. (*With six plates*)... 1

OBSERVATIONS ON THE DIET OF FLAMINGOES. By M. W. Ridley........ 5

A NEW SAND LARK FROM WESTERN INDIA (SAURASHTRA). By C. Vaurie and K. S. Dharmakumarsinhji........ 8

ON THE OCCURRENCE OF *Ephedra* IN THE INDIAN DESERT. By M. M. Bhandari. (*With one photograph*)........ 10

SOME BREEDING BIRDS OF SINGAPORE. PART III. By W. T. Loke. (*With five plates*)........ 14

A CONTRIBUTION TO THE ORNITHOLOGY OF THE DARJEELING AREA. By M. D. Lister........ 20

BACK-WATER FLORA OF THE WEST COAST OF SOUTH INDIA. By Sri C. Rajasekhara Mudaliar, M.A., and H. Sunanda Kamath, B.SC. (*With a text figure*)........ 69

A NOTE ON THE POSITION OF RHINOCEROS IN THE UNION OF BURMA (1953). By U Tun Yin........ 83

POISONOUS SEEDS OF INDIA. PART I. By S. L. Nayar........ 88

A CONTRIBUTION TO THE FLORA OF MUSSOORIE. By N. A. Watts........ 106

PERIODICITY OF THE PLANKTON DIATOMS OF THE CHILKA LAKE FOR THE YEARS 1950 AND 1951. By J. C. Roy. (*With two maps and two text figures*)........ 112

GROWTH-RATE OF THE PEARL OYSTER, *Pinctada pinctada* IN THE GULF OF KUTCH WITH A NOTE ON THE PEARL FISHERY OF 1953. By S. V. Gokhale, C. R. Easwaran and R. Narsimhan. (*With five text figures*)........ 124

CRITICAL NOTES ON THE IDENTITY AND NOMENCLATURE OF SOME BOMBAY PLANTS. III. *Murdannia scapiflorum* (Roxb.) Royle. By R. Fernandes, B.SC., and H. Santapau, S.J. (*With two plates*)........ 137

THE DEVELOPMENT OF CEYLON'S FISHING INDUSTRY. By E. R. A. de Zylva........ 142

SMITHSONIAN INSTITUTION DEC 1 1

PAGE

THE GENUS *Cymbopogon* SPRENG. IN INDIA, BURMA AND CEYLON. PART II. By N. L. Bor. (*With 27 text figures*). 149

NATURAL HISTORY OF THE SOUTH INDIAN GERBILLE *Tatera indica cuvieri* (WATERHOUSE). By M. R. N. Prasad...... 184

NEW SPECIES OF INDIAN PLANTS. By R. Seshagiri Rao... 190

REVIEWS ;—

1. Animal Wonderland—Essays in Natural History. By Frank W. Lane. (D.E.R.)...................... 192
2. Leopard of the Hills. By James Temple. (P.A.G.E.) 192
3. The Birds of Burma. By B. E. Smythies. (C.E.H.) 193
4. Hoofed Mammals of the World. By Ugo Mochi and T. Donald Carter. (S. Thomas Satyamurti). 195
5. The Pharmacognosy of Ayurvedic Drugs. Series 1, No. 2. (H. Santapau, S.J.)........................ 196
6. The Indian Pharmaceutical Codex. Volume I. (H. Santapau, S.J.)................................ 197
7. The Birds of the British Isles. By David A. Bannerman and George E. Lodge. Volume I and II. (H. G. A.).. 198
8. The Birds of West and Equatorial Africa, 2 volumes. By David A. Bannerman. (H.G.A.) 199

ADDITIONS TO THE SOCIETY'S LIBRARY.............................. 199

MISCELLANEOUS NOTES :—

1. Man-eating Tiger in South India. By R. C. Morris.. 201
2. Panther killed by domestic Buffaloes. By J. M. Power.. 201
3. More notes on the Indian Buffalo. By R. P. Noronha.. 202
4. Gaur attacking Man. By R. C. Morris.............. 204
5. Thamin or Eld's Deer *Panolia eldi thamin* (Thomas). By Tun Yin.. 205
6. Stride of Elephant crossing trench. By R. C. Morris.. 206
7. Death of wild Elephants, from suspected food-poisoning, in Travancore-Cochin State. By N. G. Pillai.. 206
8. Birds eating the poisonous fruit of the Yellow Oleander (*Thevetia neriifolia*). By S. M. Krishnan. 207

PAGE

9. Migration of insectivorous Birds in Madhya Pradesh in 1953. By C. E. Hewetson............ 207
10. Strange behaviour of a House Crow. By C. H. Biddulph.. 208
11. Possible association between the Large Yellow-naped Woodpecker and the Large Racket-tailed Drongo. By C. H. Biddulph...................... 209
12. *Cuculus canorus bakeri* in Bombay. By Humayun Abdulali.. 210
13. Occurrence of Redwinged Crested Cuckoo (*Clamator coromandus*) in Madras. By S. M. Krishnan. 210
14. Goshawk (*Astur gentilis*) in Bhavnagar (Saurashtra). By K. S. Dharmakumarsinhji........................ 211
15. Occurrence of the Banded Crake [*Rallus eurizonoides amuroptera* (Jerdon)] in Travancore. By M. C. A. Jackson.. 211
16. Food of the Bull Frog. By T. Gay..................... 212
17. The record Indian Crocodile. By Humayun Abdulali.. 213
18. An addition to the list of Snakes of Bombay and Salsette—*Uropeltis macrolepis* (Peters)—Uropeltidae. By V. K. Chari................................ 213
19. Further comment on the Mani-jal of the Chilka Lake—A special Net for Beloniform fishes. By S. Jones and K. H. Sujansinghani................. 214
20. Aposematic Insects and their Food-plants. By D. G. Sevastopulo, F.R.E.S.......................... 215
21. Aposematic Insects and their Food-plants. By C. McCann 216
22. Occurrence of *Danais chrysippus* var. *dorippus* at Dum Dum air port. By A. E. G. Best........... 218
23. Hunters' Sugar. By W. S. Thom..................... 218
24. Occurrence of Corymorpha (*Hydrozoa*) in Indian Waters. By M. R. Ranade, M.SC. (Hons.). (*With a text figure*).. 219
25. A six-locular Capsule on the Cotton Plant. By G. W. Deodhar.. 221
26. Occurrence of a bifoliate Leaf in *Citrus aurantium* L. By S. Kalyanasundaram. (*With a sketch*)...... 221
27. Proliferation in Grass. By R. B. Majumdar......... 222

PAGE

28. The flowering of *Strobilanthes auriculatus* Nees. By Mrs. Jamal Ara........ 223
29. Abnormalities in the fruit of *Areca catechu* L. By T. S. Ramakrishnan. (*With a text figure*)...... 224
30. Effect of Margosa (*Azadirachta indica*) leaves on the rotting of Potato tubers during storage. By S. L. Tandon........ 225
31. Variation in the floral parts of *Solanum melongena* L. By G. P. Argikar and M. S. Solanki (*With a text figure*)........ 226
32. Chapters on the History of Botany in India, by I. H. Burkill, in this Journal 51: 846-878. A Correction. By S. P. Agharkar, Ph.D., F.N.I........... 228

Gleanings........ 228

Notes and News........ 231

Corrigenda, Vol. 51, No. 4........ 232

Nos. 2 & 3

WILD LIFE PRESERVATION IN INDIA. Annual Report for 1953 on the Eastern Region. By E. P. Gee, M.A., C.M.Z.S........ 233

COMMENTS ON THE BIOGEOGRAPHY OF ARABIA WITH PARTICULAR REFERENCE TO BIRDS. By S. Dillon Ripley. (*With two maps*)........ 241

OBSERVATIONS ON THE HABITS OF TWO SPIDER MIMICS OF THE RED ANT, *Oecophylla smaragdina* (FABR.). By A. P. Mathew, M.A., Ph.D. (*With five text figures*)........ 249

WILD LIFE PRESERVATION AND SANCTUARIES IN THE UNION OF BURMA. By U Tun Yin, B.A., B.C.S. (*With a map*)... 264

ABORIGINAL METHODS EMPLOYED IN KILLING AND CAPTURING GAME. By K. M. Kirkpatrick. (*With six text figures*)........ 285

A SUPPLEMENTARY NOTE ON THE STATUS OF RHINOCEROS AND THAMIN (*Panolia eldi thamin*) IN THE UNION OF BURMA, 1953. By U Tun Yin, B.C.S. (Retd.)........ 301

REPORT ON THE FORESTS OF THE NORTH TRIANGLE, KACHIN STATE, NORTH BURMA. By F. Kingdon-Ward, B.A. (Cantab.), O.B.E., F.L.S., V.M.H........ 304

PAGE

FOOD OF THE INDIAN GERBILLE *Tatera indica cuvieri* (WATERHOUSE). By M. R. N. Prasad. (*With one histogram*) ... 321

THE WHALE SHARK, *Rhineodon typus* (SMITH). By Charles McCann, F.L.S. (*With two plates*) ... 326

PETRELS, SHEARWATERS AND OTHER OCEANIC BIRDS IN THE NORTH INDIAN OCEAN. By W. W. A. Phillips ... 334

OBSERVATIONS ON *Tilapia mossambica* PETERS IN MADRAS. By P. I. Chacko and B. Krishnamurthi. (*With six text figures*) ... 349

ON THE STRUCTURE AND POPULATION OF THE NEST OF THE COMMON INDIAN TREE ANT, *Crematogaster dohrni rogenhoferi* MAYR (HYMENOPTERA, FORMICIDAE). By M. L. Roonwal. M.SC., Ph.D. (Cantab.), F.N.I., F.Z.S.I. (*With one table, one text figure and three plates*) ... 354

NOTES ON THE BUTTERFLIES OF THE NAGALAPURAM HILLS, EASTERN GHATS. By A. E. G. Best ... 365

THE BIRDS OF GUJARAT. PART I. By Sálim Ali. (*With a map and five plates*) ... 374

BIOLOGY AND ECOLOGY OF ORIENTAL TERMITES (ISOPTERA). No. 1.—*Odontotermes parvidens* Holmg. & Holmg. severely damaging the bark and contributing to the death of standing Teak trees in Uttar Pradesh, India. By M. L. Roonwal, M.SC., Ph.D. (Cantab.), F.N.I., F.Z.S.I. (*With two tables and a plate*) ... 459

BIOLOGY AND ECOLOGY OF INDIAN TERMITES (ISOPTERA). No. 2.—On Ecological Adjustment in Nature between two species of Termites *Coptotermes heimi* (Wasm.) and *Odontotermes redemanni* (Wasm.) in Madhya Pradesh, India. By M. L. Roonwal, M.SC., Ph.D. (Cantab), F.N.I., F.Z.S.I. (*With a plate and* 1 *text-figure*). 463

NOTES ON LAND LEECHES. By J. L. Harrison ... 468

A SYNOPSIS OF THE SPECIES OF THE GENUS *Ozobranchus* (DE QUATREFAGES 1852) HIRUDINEA-ANNELIDA. By P. J. Sanjeeva Raj, M.A. ... 473

A NEW SPECIES OF *Arthraxon* FROM PURANDHAR (BOMBAY STATE). By F. R. Bharucha and Y. Satyanarayan. (*With a plate*) ... 481

THE VEGETATION OF PILANI AND ITS NEIGHBOURHOOD. By T. S. Bakshi. (*With a map*) ... 484

PAGE

POISONOUS SEEDS OF INDIA. PART II. By S. L. Nayar...... 515

THE GENUS *Cyathula* LOUR. IN INDIA. By T. S. Bakshi...... 533

THE ECOLOGY AND BEHAVIOUR OF THE SCORPION *Palamnaeus bengalensis* C. KOCH. By M. S. Kanungo, M.SC. (*With two text figures*).. 536

CHECKLIST OF THE TRIDACTYLIDAE AND GRYLLIDAE (INSECTA, ORTHOPTERA) OF CEYLON, WITH RECORDS OF DISTRIBUTION. By T. R. Sandrasagar, F.R.E.S............ 540

OBITUARIES :—

Sir Peter Clutterbuck.. 563

Charles M. Inglis (*With a photo*).. 565

REVIEWS :—

1. Jungle Lore. By Jim Corbett (M.R.S.C.)........... 569
2. The Snakes of India and Pakistan. By Lieut-Col. K. G. Gharpurey, I.M.S. (J.C.D.)..................... 569
3. A Field Guide to the Birds of Britain and Europe. By Roger Peterson, Guy Mountfort and P.A.D. Hollom. (S.A.).. 570
4. Poisonous Plants of India. By Sir Ram Nath Chopra, Rattan Lall Badhwar and Sudhamoy Ghosh. (H. Santapau, S.J.)............................ 571
5. The Birds of Travancore and Cochin. By Sálim Ali. (B. Biswas).. 573

ADDITIONS TO THE SOCIETY'S LIBRARY........................... 575

MISCELLANEOUS NOTES :—

1. Swimming and locomotion of captive Hedgehogs. By Ishwar Prakash.. 584
2. Effect of Earthquake on Elephants. By Frank Nicholls.. 585
3. Rorqual Whale near Badagara, Malabar Coast. By P. I. Chacko and M. J. Mathew..................... 585
4. A large Tiger. By T. B. Hawkins.................. 586
5. Habits of the Asiatic Black Bear (*Selenarctos thibetanus thibetanus* G. Cuvier). By U Tun Yin. 586
6. Longevity of the Ceylon Ruddy Mongoose (*Herpestes smithi zeylanicus*) in captivity. By W. W. A. Phillips.. 587

PAGE

7. Record Sambar for the Nilgiris. By Lt.-Col. E. G. Phythian-Adams 588
8. Malformation in antlers of the Malayan Sambar. By H. J. Kitchener. (*With a photo*) 588
9. Shikar in India. By K. M. Kirkpatrick 589
10. Intelligence of the Indian Elephant. By K. Kadambi 590
11. The Abominable Snowman. By Editors. (*With a photo*) 594
12. The occurrence of the Crested Bunting (*Melophus lathami*) in Saurashtra. By Y. S. Shivrajkumar. 598
13. An intelligent Myna. By Mrs. Syamala Murthy 598
14. Bayas and Fireflies. By P. G. S. Hall 599
15. More notes on Finn's Baya (*Ploceus megarhynchus*). By Humayun Abdulali 599
16. Sparrows nesting in colonies in Trees. By Humayun Abdulali 601
17. A Display of the Redwinged Bush-Lark (*Mirafra erythroptera* Blyth). By K. M. Kirkpatrick 601
18. The courtship display of the Large Pied Wagtail (*Motacilla maderaspatensis* Gmelin). By K. M. Kirkpatrick 602
19. The occurrence of Franklin's Nightjar (*Caprimulgus monticolus monticolus*) in Travancore-Cochin. By M. C. A. Jackson 603
20. Occurrence of spurs in the female Junglefowl (*Gallus sonnerati*). By Editors 603
21. The Great Indian Bustard. By Editors 604
22. Occurrence of the Blacknecked Crane (*Grus nigricollis*) in Indian limits. By F. N. Betts 605
23. The status of the Pheasant-tailed Jaçana (*Hydrophasianus chirurgus*) in South India. By C. H. Biddulph 606
24. Occurrence of Bronzecapped or Falcated Teal (*Eunetta falcata*) near Calcutta. By J. N. Taylor. 607
25. Birds associating Natural Phenomena with Food Supply. By Charles McCann, F.L.S 607
26. Some bird notes from Chingleput District, Madras. By Rev. E. O. Shaw 609

PAGE

27. Birds seen above the tree-line in Tehri-Garhwal, in the Central Himalayas. By H. F. Lamprey. (*With two plates*)........ 610

28. The secondary song of Birds. By K. K. Neelakantan........ 615

29. Pythons. By Frank Nicholls........ 620

30. Notes on the Frog *Rana breviceps* Schneider. By J. L. Bhaduri and Mira Kirpalani. (*With a sketch*)........ 620

31. A record of the Whale Shark (*Rhineodon typus* Smith) from the Malabar Coast. By P. I. Chacko and M. J. Mathew........ 623

32. Food Organisms of *Gadusia chapra* (Ham.) from certain ponds with thick *Euglena* blooms. By P. Mohapatra........ 624

33. The relations of total length to furcal length for five Cyprinids. By P. Mohapatra. (*With five graphs*........ 626

34. Effect of jaggery on Fish Life. By P. I. Chacko and R. Srinivasan........ 629

35. Spawning of Rohu at Powai Lake. By F. R. Goldschmidt........ 634

36. Distribution of *Rana leithii* Bouleng.—A Correction. By Humayun Abdulali and J. C. Daniel... 635

37. Extension of range of *Rana temporalis* Günth. By Humayun Abdulali........ 636

38. Extension of range of the Frog *Uperodon globulosum* Günth. By Humayun Abdulali and J. C. Daniel........ 637

39. Food of the Bull-Frog (*Rana tigrina*). By (Mrs.) Aruna Banerji........ 639

40. Distribution and habits of the Batrachian *Ichthyophis glutinosus* Linn. By Humayun Abdulali... 639

41. A note on the courtship in the Sand Crab [*Philyra scabriuscula* (Fabricius)]. By (Miss) K. G. Raja Bai Naidu........ 640

42. Sex ratio and variability of apodous segments in *Apus* (Phyllopoda : Crustacea). By Krishna Kant Tiwari........ 641

PAGE

43. Occurrence of the Mantis *Gongylus gongyloides* Linn. in Junagadh (Saurashtra). By I. H. Kachhi. 644
44. On some unrecorded Host Plants of the Lac Insect, *Laccifer lacca* (Kerr), (Homoptera: Lacciferidae). By A. P. Kapur, M.SC., Ph.D. (Lond.), D.I.C. ... 645
45. Presumptive fatal sting of the common House Wasp, *Polistes hebraeus*. By J. N. Onial, P.F.S. (Retd.) ... 647
46. Some Insects attracted to Light. By S. Usman... 647
47. Leeches. By R. N. Champion-Jones... 650
48. Land Leeches. By Lt.-Col. F. M. Bailey... 652
49. Land Leeches. By J. L. H. Williams... 652
50. Land Leeches. By R. S. Mathews... 655
51. 'Nwe-Shin' or 'Live Creeper'. By H. G. Hundley. 656
52. Identity and taxonomical status of *Sesamum ekambaramii* Naidu. By S. Ramanujam and A. B. Joshi... 657
53. The Genus *Murdannia* in Bombay State. By H. Santapau, S.J. ... 658
54. The Genus *Murdannia* in Bombay—Further Corrections. By H. Santapau, S.J. ... 658
55. Some recently introduced or newly recorded Plants from Patna District and its neighbourhood. By J. G. Srivastava... 659
56. A note on *Ventilago gamblei* Merrill. By M. B. Raizada... 660
57. New plant records for Bombay. By R. Fernandes, B.SC., A. Randeria, B.SC., and H. Santapau, S.J. (*With two plates*)... 661
58. E. J. Woodhouse—His contribution to our knowledge of the Flora of Bihar. By J. G. Srivastava. 663

GLEANINGS... 665

NOTES AND NEWS... 668

Annual Report of the Bombay Natural History Society for the year ending 31st December 1953... 669

Minutes of the Annual General Meeting of the Bombay Natural History Society held in the Conference Hall of the B.E.S. and T. Undertaking, Electric House, Ormiston Road, Bombay, on Monday the 23rd August 1954, at 6 p.m. 684

No. 4

PAGE

TWO BITTERNS IN A PENANG MARSH. PART I. By Loke Wan Tho. (*With one coloured and three black and white plates*). 687

TECTONIC HISTORY OF INDIA AND ITS BEARING ON FISH GEOGRAPHY. By S. L. Hora, D.SC., F.N.I. (*With 7 text figures*).. 692

SOME STUDIES ON TWO SPECIES OF INDIAN FIDDLER CRABS, *Uca marionis nitidus* (Dana) and *U. annulipes* (Latr.). By R. Altevogt. (*With* 13 *figures and one table*)........... 702

THE MANAGEMENT OF INDIA'S WILD LIFE SANCTUARIES AND NATIONAL PARKS. PART II. By E. P. Gee, M.A., C.M.Z.S. (*With four plates*)................................ 717

THE BIRDS OF GUJARAT. PART II. By Sálim Ali. (*With one plate*).. 735

MISCELLANEOUS NOTES ON INDIAN BUTTERFLIES. By D. F. Sanders.. 803

COMPARATIVE OBSERVATIONS ON THE PLACENTA AND FOETAL NUTRITION IN ELASMOBRANCHS AND MAMMALS. By P. N. Sarangdhar, M.SC., PH.D. (*With two plates*)...... 831

GROWTH-GRADIENTS OF INDIAN ELEPHANTS. By Bernhard Rensch and K. W. Harde. (*With eleven figures*)........... 841

Nyctibatrachus humayuni, A NEW FROG FROM THE WESTERN GHATS, BOMBAY. By J. L. Bhaduri, D.SC., F.N.I., F.A.S., F.Z.S.I., and Miss M. B. Kripalani, M.SC. With Field Notes by Humayun Abdulali. (*With a plate*)................ 852

Ixodes kerri, A NEW SPECIES OF TICK FROM A FLYING SQUIRREL FROM SOUTHERN INDIA (ACARINA: IXODIDAE). By T. Ramachandra Rao, D.SC. (*With two plates*)........ 860

WILD LIFE PRESERVATION IN INDIA. Annual Report for 1953 on the Western Region. By K. S. Dharmakumarsinhji.. 865

HABITS AND HABITAT OF SOME COMMON SPIDERS FOUND IN WESTERN INDIA. By T. V. Subrahmaniam. (*With sixteen text figures*).. 874

SOME BIRDS COLLECTED IN LANGTANG KHOLA, RASUA GARHI DISTRICT, CENTRAL NEPAL. By O. Polunin, M.A., F.L.S. 886

A NEW SPECIES OF *Chlorophytum* from SALSETTE ISLAND. By H. Santapau, S.J., F.N.I., and R. R. Fernandes, B.SC. (*With a plate*).. 897

PAGE

A NEW FORM OF THE BURROWING SNAKE, *Uropeltis macrolepis* (PETERS) FROM MAHABLESHWAR. By V. K. Chari ... 901

REVIEWS :—

1. Indian Journal of Fisheries ... 902
2. Common Indian Herbs. By N. A. Watts
3. Flora of Agra District. A descriptive Key to the Flora of Agra District. By N. A. Watts. (H. Santapau, S.J.) ... 903
4. A Coloured Atlas of some Vertebrates from Ceylon, Vol. II. Tetrapod Reptilia. By P.E.P. Deraniyagala. (V.K.C.) ... 904
5. Bird Life. By Niko Tinbergen. (S.A.) ... 905
6. The Waterfowl of the World. By Jean Delacour. Vol. I. (S.A.) ... 906
7. The Temple Tiger and more Man-eaters of Kumaon. By Jim Corbett. (L.F.) ... 907
8. Birds of Arabia. By Col. R. Meinertzhagen, D.S.O. (S.A.) ... 908
9. The Birds of the British Isles. Vol. III. By David A. Bannerman and George E. Lodge. (S.A.) ... 910
10. A Wanderer in the Wind: The Odyssey of an Animal Collector. By Cecil S. Webb. (H.A.) ... 911

ADDITIONS TO THE SOCIETY'S LIBRARY ... 912

MISCELLANEOUS NOTES :—

1. Strange behaviour of Monkeys in the presence of a Panther. By Sirdar Bhupendra Kumar ... 913
2. Unrecorded sounds made by the Tiger. By Lt.-Col. R. W. Burton, I.A. (Retd.) ... 915
3. Cat and Mongoose. By T. Gay ... 916
4. Extraordinary behaviour of a solitary Bull Bison (Gaur). By R. C. Morris ... 916
5. The Brow-antlered Deer (*Cervus eldi* MacClelland). By E. P. Gee. (*With a plate*) ... 917
6. Thamin or Brow-antlered Deer in the Zoological Gardens, Rangoon. By Tun Yin. (*With a plate*). 919
7. Abnormal horns of a Blackbuck (*Antilope cervicapra*). By C. H. Biddulph. (*With a photo*) ... 920

PAGE

8. Notes on the Desert Hedgehog (*Hemiechinus auritus collaris* Gray). By Ishwar Prakash........... 921
9. Cannibalism in Hedgehogs. By Ishwar Prakash... 922
10. Wild Life Preservation in India. The Area of the former Gilgit Agency. By Lt.-Col. R. W. Burton, I.A. (Retd.).................................. 923
11. New light upon the Natural History of Malabar. By C. H. Biddulph...................................... 924
12. A Bird answering its own Echo. By T. Gay......... 925
13. Another bird-watching pilgrimage to SW. Tibet. By K. S. Lavkumar. (*With a map*).............. 925
14. Has the Cuckoo a protrusible Ovipositor? By Charles McCann, F.L.S................................ 931
15. Mating of Partridges. By Editors...................... 932
16. The bone-dropping habit of the Lämmergeier. By Robert L. Fleming, ph.D.............................. 933
17. Heron-keeping on the Indus River. By P. I. R. Maclaren. (*With a photo*).......................... 935
18. Trapping Birds for ringing. By Zafar Futehally. (*With a photo*).. 936
19. The record Indian Crocodile. By Lt.-Col. R. W. Burton, I.A. (Retd.).................................. 937
20. Some notes on *Rana beddomii* Günther with an extension of its range. By Humayun Abdulali and J. C. Daniel...................................... 938
21. Presumptive eating of a Krait by Scorpions. By Ishwar Prakash and K. C. Dave..................... 939
22. A grateful Skink. By T. Gay.............................. 940
23. Hunting the Land Crab [*Paratelphusa guerini* (M.-Edw.)]. By Jabir A. Ali, B.A. (Cantab.), C.D., Ag. (*With a text-figure*)................................ 941
24. *Apus* (Crustacea : Phyllopoda), a new host for parasitic Nematodes. By K. K. Tiwari........... 945
25. An unusual Crab Fishery in the sea off Ennur, near Madras. By P. I. Chacko and E. Palani. (*With a text figure*).. 946
26. A new species of *Antrocephalus* Kirby. By B. R. Subba Rao, B.Sc. (Hons.), Assoc. I.A.R.I. (*With a text-figure*).. 948

PAGE

27. Some Insects attracted to Light—II. By S. Usman. 950
28. Notes on *Thrips palmi* Karny, attacking *Sesamum indicum.* By T. N. Ananthakrishnan, B.SC. (Hons.), F.Z.S., F.R.E.S. (*With a plate and a text-figure*)... 951
29. Aposematic Insects and their Food-plants. By D. G. Sevastopulo F.R.E.S.................. 953
30. A four-leaved Oleander. By G. W. Deodhar, B.A., M.SC.................. 954
31. On the occurrence of *Marsilea aegyptiaca* Willd. in Jodhpur, Rajasthan (India). By K. M. Gupta. (*With a plate*).................. 954
32. *Alternanthera polygonoides* R. Br., var. *erecta* Mart. — A new record for Bombay State. By G. P. Shrivastava, M.SC., and H. Santapau, S.J. (*With a plate*).................. 957
33. Abnormalities in the 'Ear' of *Zea mays* L. By S. L. Tandon. (*With a plate*).................. 958
34. The introduction of *Tilapia mossambica* into India — A Correction. By Editors.................. 959

GLEANINGS.................. 959

NOTES AND NEWS.................. 961

ERRATA.................. 962

AN APPEAL.................. 962

ALPHABETICAL LIST OF CONTRIBUTORS

VOLUME 52

Nos. 1, 2 & 3, and 4

PAGE

Abdulali, Humayun, *Cuculus canorus bakeri* in Bombay ... 210

——————, The record Indian Crocodile ... 213

——————, More Notes on Finn's Baya (*Ploceus megarhynchus*) 599

——————, Sparrows nesting in colonies in Trees, 601

——————, Extension of range of *Rana temporalis* Günth. 636

——————, Distribution and habits of the Batrachian, *Ichthyophis glutinosus* Linn. 639

——————, and Daniel, J. C., Distribution of *Rana leithii* Bouleng.—A Correction. 635

——————, Extension of range of the Frog *Uperodon globulosum* Gunth. 637

——————, Some notes on *Rana beddomii* Günther, with an extension of its range 938

——————, see Bhaduri, J. L. ... ...

Agharkar, S. P., Ph.D., F.N.I., Chapters on the History of Botany in India, by I. H. Burkill, in this Journal 51: 846-878. A Correction ... 228

Ali, Jabir A., B.A. (Cantab.), C.D., Ag., Hunting the Land Crab *Paratelphusa guerini* (M.-Edw.) 941

Ali, Sálim, The Birds of Gujarat. Part I. 374

—————— Part II. 735

Altevogt, R., Some Studies on two Species of Indian Fiddler Crabs, *Uca marionis nitidus* (Dana) and *U. annulipes* (Latr.) 702

Ananthakrishnan, T.N., B.Sc. (Hons.), F. Z. S., F .R. E. S., Notes on *Thrips palmi* Karny, attacking *Sesamum indicum* 951

Ara, Mrs. Jamal, The flowering of *Strobilanthes auriculatus* Nees 223

Argikar, G. P., and Solanki, M. S., Variation in the floral parts of *Solanum melongena* L. 226

Bailey, F. M., Lt.-Col., Land Leeches 652

Bakshi, T. S., The Vegetation of Pilani and its Neighbourhood 484

——————, The Genus *Cyathula* Lour. in India ... 533

Banerji, (Mrs.) Aruna, Food of the Bull-Frog (*Rana tigirina*) 639

Best, A. E. G., Occurrence of *Danais chrysippus* var. *dorippus* at Dum Dum air port ... 218

——————, Notes on the Butterflies of the Nagalapuram Hills, Eastern Ghats... 365

Betts, F. N., Occurrence of the Blacknecked Crane (*Grus nigricollis*) in Indian limits. 605

Bhaduri, J.L., and Kirpalani, Mira, Notes on the Frog *Rana breviceps* Schneider ... 620

——————, and Kirpalani, Miss M. B. With Field Notes by Abdulali, Humayun. *Nyctibatrachus humayuni*, a new Frog from the Western Ghats, Bombay 852

PAGE

Bhandari, M. M., On the Occurrence of *Ephedra* in the Indian Desert 10

Bharucha, F. R., and Satyanarayan, Y., A new Species of *Arthraxon* from Purandhar (Bombay State) 481

Biddulph, C. H., Strange behaviour of a House Crow ... 208

———, Possible association between the Large Yellow-naped Woodpecker and the Large Racket-tailed Drongo 209

———, The status of the Pheasant-tailed Jaçana (*Hydrophasianus chirurgus*) in South India 606

———, Abnormal horns of a Blackbuck (*Antilope cervicapra*) 920

———, New light upon the Natural History of Malabar 924

Bor, N. L., The Genus *Cymbopogon* Spreng. in India, Burma and Ceylon. Part II. 149

Burton, Lt.-Col. R. W., I.A. (Retd.), Unrecorded sounds made by the Tiger 915

———, Wild Life Preservation in India. The Area of the former Gilgit Agency 923

———, The record Indian Crocodile ... 937

Chacko, P. I., and Krishnamurthi, B., Observations on *Tilapia mossambica* Peters in Madras 349

———, and Mathews, M. J., A record of the Whale Shark (*Rhineodon typus* Smith) from the Malabar Coast 623

———, and Palani, E., An unusual Crab Fishery in the sea off Ennur, near Madras 946

———, and Srinivasan, R., Effect of jaggery on Fish Life 269

PAGE

Champion-Jones, R. N., Leeches 650

Chari, V. K., An addition to the list of Snakes of Bombay and Salsette—*Uropeltis macrolepis* (Peters)—Uropeltidae. 213

———, A new form of the Burrowing Snake, *Uropeltis macrolepis* (Peters) from Mahableshwar 901

Daniel, J. C., *see* Abdulali, Humayun

Dave, K. C., *see* Prakash, Ishwar

Deodhar, G. W., A six-locular Capsule on the Cotton Plant... 221

———, A four-leaved Oleander 954

Dharmakumarsinhji, K. S., Goshawk (*Astur gentilis*) in Bhavnagar (Saurashtra) ... 211

———, Wild Life Preservation in India. Annual report for 1953 on the Western Region ... 865

———, *see* Vaurie, C.

de Zylva, E. R. A., The Development of Ceylon's Fishing Industry 142

Easwaran, C. R., *see* Gokhale, S. V.

Editors, The Abominable Snowman 594

———, Occurrence of spurs in the female Junglefowl (*Gallus sonnerati*) ... 603

———, The Great Indian Bustard 604

———, Mating of Partridges 932

———, The Introduction of *Tilapia mossambica* into India—A Correction ... 959

Fernandes, R., B.Sc., Randeria, A., B.Sc., and Santapau, H., S.J., New plant Records for Bombay ... 661

———, and Santapau, H., S.J., Critical Notes on the Identity and Nomenclature of some Bombay Plants III. *Murdannia scapiflorum* (Roxb.) Royle 137

PAGE

FERNANDES, R., B.SC., RANDERIA, A., B.SC., *see* SANTAPAU, H., S.J., F.N.I.

FLEMING, ROBERT L., PH.D., The bone-dropping habit of the Lämmergeier 933

FUTEHALLY, ZAFAR, Trapping Birds for ringing 936

GAY, T., Food of the Bull Frog. 212

———, Cat and Mongoose ... 916

———, A Bird answering its own Echo 925

GEE, E. P., M.A., C.M.Z.S., Wild Life Preservation in India : Annual Report for 1953 on the Eastern Region ... 233

———, The Management of India's Wild Life Sanctuaries and National Parks. Part II 717

———, The Brow-antlered Deer (*Cervus eldi* MacClelland) 917

GOKHALE, S. V., EASWARAN, C. R., and NARSIMHAN, R., Growth-rate of the Pearl Oyster, *Pinctada pinctada* in the Gulf of Kutch with a note on the Pearl Fishery of 1953 124

GOLDSCHMIDT, F. R., Spawning of Rohu at Powai Lake ... 634

GUPTA, K. M., D.SC., On the occurrence of *Marsilea aegyptiaca* Willd. in Jodhpur, Rajasthan (India) 954

HALL, P. G. S., Bayas and Fireflies 599

HARDE, K. W., *see* RENSCH, BERNHARD

HARRISON, J. L., Notes on Land Leeches 468

HAWKINS, T. B., A large Tiger 586

HEWETSON, C. E., Migration of insectivorous Birds in Madhya Pradesh in 1953 207

HORA, S. L., D.SC., F.N.I., Tectonic History of India and its bearing on Fish Geography. 692

PAGE

HUNDLEY, H. G., 'Nwe-Shin' or 'Live Creeper' 656

JACKSON, M. C. A., Occurrence of the Banded Crake [*Rallus eurizonoides amuroptera* (Jerdon)] in Travancore 211

———, The occurrence of Franklin's Nightjar (*Caprimulgus monticolus monticolus*) in Travancore-Cochin 603

JONES, S., and SUJANSINGHANI, K. H., Further comment on the Mani-jal of the Chilka Lake—A special Net for Belloniform fishes 214

JOSHI, A. B., *see* RAMANUJAM, S.

KACHHI, I. H., Occurrence of the Mantis *Gongylus gongyloides* Linn. in Junagadh (Saurashtra) 644

KADAMBI, K., Intelligence of the Indian Elephant ... 590

KALYANASUNDARAM, S., Occurrence of a bi-foliate leaf in *Citrus aurantium* L. ... 221

KAMATH, H. SUNANDA, B.SC., *see* MUDALIAR, Sri C. RAJASEKHARA, M.A.

KANUNGO, M. S., M.SC., The Ecology and Behaviour of the Scorpion *Palamnaeus bengalensis* C. Koch 536

KAPUR, A. P., M.SC., PH.D., D.I.C., On some unrecorded Host Plants of the Lac Insect, *Laccifer lacca* (Kerr), (Homopetera: Lacciferidae) ... 645

KINGDON-WARD, F., B.A. (Cantab.), O.B.E., F.L.S., V.M.H., Report on the Forests of the North Triangle, Kachin State, North Burma 304

KIRKPATRICK, K. M., Aboriginal methods employed in killing and capturing Game... 285

———, Shikar in India 589

———, A Display of the Redwinged Bush-Lark (*Mirafra erythroptera* Blyth) 601

PAGE

Kirkpatrick K. M., The courtship Display of the Large Pied Wagtail (*Motacilla maderaspatensis* Gmelin) ... 602

Kirpalani, Mira, *see* Bhaduri, J. L.

Kitchener, H. J., Malformation in antlers of the Malayan Sambar 588

Kripalani, Miss M. B., M.Sc., *see* Bhaduri, J. L.

Krishnamurthi, B., *see* Chacko, P. I.

Krishnan, S. M., Birds eating the poisonous fruit of the Yellow Oleander (*Thevetia neriifolia*) 207

————————, Occurrence of Redwinged Crested Cuckoo (*Clamator coromandus*) in Madras 210

Kumar, Sirdar Bhupendra, Strange behaviour of Monkeys in the presence of a Panther. 913

Lamprey, H. F., Birds seen above the tree-line in Tehri-Garhwal, in the Central Himalayas 610

Lavkumar, K. S., Another bird-watching pilgrimage to SW. Tibet 925

Lister, M. D., A contribution to the Ornithology of the Darjeeling area 20

Loke, Wan Tho, Some breeding Birds of Singapore. Part III. 14

————————, Two Bitterns in a Penang Marsh. Part I. 687

Macdonald, A. St. J., Wild Life Preservation—Kruger National Park. An example. 1

MacLaren, P.I.R., Heron-keeping on the Indus River ... 935

Majumdar, R. B., Proliferation in Grass 222

Mathew, A. P., M.A., Ph. D., Observations on the Habits of two Spider Mimics of the Red Ant, *Oecophylla smaragdina* (Fabr.) 249

PAGE

Mathew, M. J., *see* Chacko, P. I.

Mathews, R. S., Land Leeches. 665

McCann, Charles, Aposematic Insects and their Food-plants 216

————————, The Whale Shark *Rhineodon typus* (Smith) 326

————————, Birds associating Natural Phenomena with Food Suply 607

————————, Has the Cuckoo a protrusible Ovipositor? 931

Mohapatra, P., Food Organisms of *Gadusia chapra* (Ham.) from certain ponds with thick *Euglena* blooms 624

————————, The Relationships of total length to furcal length for five Cyprinids ... 626

Morris, R. C., Man-eating Tiger in South India 201

————————, Gaur attacking Man 204

————————, Stride of Elephant crossing trench ... 206

————————, Extraordinary behaviour of a solitary Bull Bison (Gaur) 916

Mudaliar, Sri C. Rajasekhara, M.A., and Kamath, H. Sunanda, B.Sc., Backwater Flora of the West Coast of South India 69

Murthy, Mrs. Syamala, An intelligent Myna 598

Naidu, (Miss) K. G. Raja Bai, A note on the courtship in the Sand Crab [*Philyra scabriuscula* (Fabricius)] ... 640

Narsimhan, R., *see* Gokhale, S. V.

Nayar, S. L., Poisonous Seeds of India. Part I. 88

————————, Part II. ... 515

Neelakantan, K. K., The secondary song of Birds ... 615

Nicholls, Frank, Effect of Earthquake on Elephants ... 585

PAGE

NICHCOLS FRANK, Pythons ... 620

NORONHA, R. P., More notes on the Indian Buffalo ... 202

ONIAL, J. N., P.F.S. (Retd.), Presumptive fatal sting of the common House Wasp, *Polistes hebraeus* 647

PALANI, E., *see* CHACKO, P. I.

PHILLIPS, W. W. A., Petrels, Shearwaters and other Oceanic Birds in the north Indian Ocean 334

————————, Longevity of the Ceylon Ruddy Mongoose (*Herpestes smithi zeylanicus*) in captivity ... 587

PHYTHIAN-ADAMS, Lt.-Col., E. G., Record Sambar for the Nilgiris 588

PILLAI, N. G., Death of wild Elephants, from suspected food-poisoning in Travancore-Cochin State 206

POLUNIN, O., M.A., F.L.S., Some Birds collected in Langtang Khola, Rasua Garhi District, Central Nepal 886

POWER, J. M., Panther killed by domestic Buffaloes ... 201

PRAKASH, ISHWAR, Swimming and locomotion of captive Hedgehogs 584

————————, Notes on the Desert Hedgehog (*Hemiechinus auritus collaris* Gray) ... 921

————————, Cannibalism in Hedgehogs 922

————————, and DAVE, K. C., Presumptive eating of a Krait by Scorpions ... 939

PRASAD, M. R. N., Natural History of the South Indian Gerbille *Tatera indica cuvieri* (Waterhouse) 184

————————, Food of the Indian Gerbille *Tatera indica cuvieri* (Waterhouse). 321

RAIZADA, M. B., A Note on *Ventilago gamblei* Merrill ... 660

RAJ, P. J. SANJEEVA, A Synopsis of the Species of the Genus *Ozobranchus* (De Quatrefages, 1852) Hirudinea—Annelida 473

RAMAKRISHNAN, T. S., Abnormalities in the fruit of *Areca catechu* L. 224

RAMANUJAM, S., and JOSHI, A. B., Identity and taxonomical Status of *Sesamum ekambaramii* Naidu ... 657

RANADE, M. R., M.SC. (Hons.), Occurrence of Corymorpha (*Hydrozoa*) in Indian Waters. 219

RANDERIA, A., B.SC., *see* FERNANDES, R., B.SC.

RAO, B. R. SUBBA, B.SC. (Hons.), A new species of *Antrocephalus* Kirby ... 948

RAO, R. SESHAGIRI, New Species of Indian Plants ... 190

RAO, T. RAMACHANDRA, *Ixodes kerri*, a new species of Tick from a Flying Squirrel from Southern India (Acarina; Ixodidae) 860

RENSCH, BERNHARD, and HARDE, K. W., Growth-gradients of Indian Elephants ... 841

RIDLEY, M. W., Observations on the Diet of Flamingoes ... 5

RIPLEY, S. DILLON, Comments on the Biogeography of Arabia with particular reference to Birds 241

ROONWAL, M. L., On the Structure and Population of the Nest of the common Indian Tree Ant, *Crematogaster dohrni rogenhoferi* Mayr (Hymenoptera, Formicidae) ... 354

————————, Biology and Ecology of Oriental Termites (Isoptera). No. 1. *Odontotermes parvidens* Holmg. & Holmg. severely damaging the bark and contributing to the death of standing Teak trees in Uttar Pradesh, India 459

PAGE

Roonwal, M. L., No. 2. On Ecological Adjustment in Nature between two species of Termites, *Coptotermes heimi* (Wasm.) and *Odontotermes redemanni* (Wasm.)—in Madhya Pradesh, India ... 463

Roy, J. C., Periodicity of the Plankton Diatoms of the Chilka Lake for the years 1950 and 1951 112

Sanders, D. F., Miscellaneous Notes on Indian Butterflies ... 803

Sandrasagara, T.B., F.R.E.S., Checklist of the Tridactylidae and Gryllidae (Insecta, Orthoptera) of Ceylon, with records of Distribution ... 540

Antapau, H., S.J., The Genus *Murdannia* in Bombay State 658

————, The Genus *Murdannia* in Bombay—Further Corrections 658

————, and Fernandes, R. R., B.Sc., A new Species of *Chlorophytum* from Salsette Island ... 897

————, *see* Fernandes, R., B.Sc.

————, *see* Shrivastava, G. P., M.Sc.

Sarangdhar, P. N., M.Sc., Ph.D., Comparative Observations on the Placenta and Foetal Nutrition in Elasmobranchs and Mammals 831

Satyanarayan, Y., *see* Bharucha, F. R. ... ...

Sevastopulo, D. G., F.R.E.S., Aposematic Insects and their Food-plants 215

————, Aposematic Insects and their Food-plants 953

Shaw, Rev. E. O., Some bird notes from Chingleput District, Madras 609

Shivrajkumar, Y. S., The Occurrence of the Crested Bunting (*Melophus lathami*) in Saurashtra 598

PAGE

Shrivastava, G. P., M.Sc., and Santapau, H., S.J., *Alternanthera polygonoides* R. Br. var. *erecta* Mart.—a new record for Bombay State 957

Solanki, M. S., *see* Argikar, G. P.

Srinivasan, R., *see* Chacko, P. I.

Srivastava, J. G., Some recently introduced or newly recorded Plants from Patna District and its neighbourhood 659

————, E. J. Woodhouse—His contribution to our knowledge of the Flora of Bihar 663

Subrahmaniam, T. V., Habits and Habitat of some common Spiders found in Western India. 874

Sujansinghani, K. H., *see* Jones, S.

Tandon, S. L., Effect of Margosa (*Azadirachta indica*) leaves on the rotting of Potato tubers during storage ... 225

————, Abnormalities in the 'Ear' of *Zea mays* L. 958

Taylor, J. N., Occurrence of Bronzecapped or Falcated Teal (*Eunetta falcata*) near Calcutta 607

Thom, W. S., Hunters' Sugar 218

Tiwari, Krishna Kant, Sex ratio and variability of apodous segments in *Apus* (Phyllopoda: Crustacea) ... 641

————, *Apus* (Crustacea: Phyllopoda), a new host for parasitic Nematodes. 945

Usman, S., Some Insects attracted to Light—I 647

————, Some Insects attracted to Light—II 950

Vaurie, C., and Dharmakumarsinhji, K. S., A new Sand Lark from Western India (Saurashtra) 8

Watts, N. A., A Contribution to the Flora of Mussoorie ... 106

PAGE

Williams, J. L. H., Land Leeches 652

Yin, U Tun, A Note on the Position of Rhinoceros in the Union of Burma (1953) ... 83

————————, Thamin or Eld's Deer [*Panolia eldi thamin* (Thomas)] in Burma ... 205

————————, Wild Life Preservation and Sanctuaries in the Union of Burma 264

————————, A Supplementary Note on the Status of Rhinoceros and Thamin (*Panolia eldi thamin*) in the Union of Burma, 1953 301

————————, Habits of the Asiatic Black Bear (*Selenarctos thibetanus thibetanus* G. Cuvier) 586

————————, Thamin or Brow-antlered Deer in the Zoological Gsrdens, Rangoon ... 917

LIST OF PLATES

VOLUME 52

Nos. 1, 2 & 3, and 4

PAGE

Wild Life Preservation — Kruger National Park. An Example

Plate I. Lion and Lioness in road ... 2
Plate II. Lions and Cars between ... 2/3
Plate III. Elephant crossing road ,, ... 2/3
Plate IV. Buffalo ... 3
Plate V. Kudu Bull ... 4
Plate VI. Giraffe crossing road ... 5

Some Breeding Birds of Singapore. Part III

Plate I. Longtailed Tailor-bird (*Orthotomus sutorius maculicollis*). ... 14
Plate II. Malay Pipit (*Anthus novaeseelandiae malayensis*) ... 15
Plate III. Yellowbreasted Sunbird (*Leptocoma j. microleuca*) on newly completed nest ... 16
Plate IV. Yellowbreasted Sunbird (*Leptocoma jugularis microleuca*) ... 17
Plate V. Yellowbreasted Sunbird (*Leptocoma j. microleuca*). Lower nest, partly completed, was abandoned when bird was frightened by flash. Another nest at once started above it ... 18

Critical Notes on the Identity and Nomenclature of some Bombay Plants III.
Murdannia scapiflorum (Roxb.) Royle

Plate I. *Murdannia scapiflorum* Royle ... 138
Plate II. *Murdannia scapiflorum* Royle ... 140

The Whale Shark, *Rhineodon typus* (Smith)

Plate I. The Basking Shark (*Cetorhinus maximus*) ... 330
Plate II. A. Showing gill arches and reduced tongue ... } 331
B. Gill arch with gill and gill rakers ... }

On the Structure and Population of the Nest of the common Indian Tree Ant, *Crematogaster dohrni rogenhoferi* Mayr (Hymenoptera, Formicidae)

Plate I. Photographs of *Crematogaster dohrni rogenhoferi* Mayr collected in New Forest, Dehra Dun, U.P. ... 356
Plate II. Photographs of young nest of *Crematogaster dohrni rogenhoferi* Mayr, from the Kankramari *char* (Island), Muriganga R., the Sunderbans, Lower Bengal ... 360
Plate III. Photographs of nest of *Crematogaster* sp. ... 361

The Birds of Gujarat. Part I.

Plate I. 1. Moist deciduous forest, Rajpipla, S. Gujarat ... } 374
2. Deciduous biotope, Surat Dangs, March ... }

PAGE

Plate II. 1. Moist deciduous secondary jungle, Surat Dangs ...
2. Looking towards Salher Fort, Navsari Dist., S. Gujarat .. } 375

Plate III. 1. Country about Balaram, Palanpur, N. Gujarat. Abu hills in the distance ...
2. Lesser Flamingos at Banas River mouth, Little Rann of Kutch ... } 376

Plate IV. 1. The Banni country, N. Kutch ...
2. Typical coastal sand-dunes, Mandvi, Kutch ... } 377

Plate V. 1. Portion of ' Flamingo City ' — Great Rann of Kutch, April 1945 ...
2. Exhausted immigrating Grey Quail sheltering under old flamingo nest-mound, Great Rann of Kutch ... } 388

Biology and Ecology of Oriental Termites (Isoptera), No. 1.

Plate I. Portions of teak trees (*Tectona grandis* Linn. f.) from the West Lehra Block, Pharenda Range, Gorakhpur Forest Division, Uttar Pradesh, damaged by the termite *Odontotermes parvidens* Holmg. & Holmg., during 1951–52 ... 460

Biology and Ecology of Oriental Termites (Isoptera), No. 2.

Plate I. Photographs of the lower portions of the trunk and of the root-stock of a recently dead, standing tree of salai, *Boswellia serrata* Roxb., showing damage by two species of termites, viz. *Coptotermes heimi* (Wasmann) and *Odontotermes redemanni* (Wasmann) ... 464

A new Species of *Arthraxon* from Purandhar (Bombay State).

Plate. *Arthraxon purandharensis* sp. nov. ... 482

Charles M. Inglis.

Plate. ... 566

Birds seen above the tree-line in Tehri-Garhwal, in the Central Himalayas.

Plate I. A view of the Alpine Meadow ... 612
Plate II. A view of the meadow showing typical rock outcrops ... 613

New Plant Records for Bombay.

Plate I. *Ipomoea triloba* Linn. ... 662
Plate II. *Commelina suffruticosa* Blume ... 663

Two Bitterns in a Penang Marsh.

Plate I. (Coloured). The Yellow Bittern (*Ixobrychus sinensis*). Female ... 687

[For the above caption, printed erroneously under the plate, read, ' The Chestnut Bittern (*Ixobrychus cinnamomeus*)].

Plate II. The Swamp area of Ginting, Penang ' Looking like a bandit with a Bren-gun stand '. ... 688
Plate III. The Yellow Bittern. Male. Female ' . . . raised her crest in threat '. ... 689
Plate IV. The Yellow Bittern. ' . . . kept butting father in his belly . . . . . '. Emptying the Larder ... 690

PAGE

Some Studies on two Species of Indian Fiddler Crabs, *Uca marionis nitidus* (Dana) and *U. annulipes* (Latr.).

Plate I. Figs. 2 and 3. Major cheliped of a small (upper) and large (lower) specimen of *Uca annulipes* ... 702
Plate II. Figs. 4–6. Major cheliped of a small, medium and large specimen of *Uca marionis nitidus* ... 703
Plate III. Fig. 7. *Uca marionis nitidus*, habitat and hole ... Fig. 8. Refused mud-pellets of *Uca* in linear arrangement radiating from entrance of crab's hole. 704
Plate IV. Spoontipped hairs of merus of second maxilliped in *Uca marionis nitidus* (Fig. 91) and *U. annulipes* (Fig. 10) ... 705
Plate V. Fig. 11. Spoontipped hairs in natural arrangement in *Uca annulipes* ... Fig. 13. Male of *Uca marionis nitidus* in display colouration waving at (feeding) female (from a 16 mm. motion-picture) ... 710

The Management of India's Wild Life Sanctuaries and National Parks. Part II.

Plate I. Wild elephant (*makna*). Kaziranga Sanctuary ... Wild buffalo bull, Kaziranga Sanctuary ... 718
Plate II. Barasingha (*Rucervus duvaucelli*) Kanha Wild Life Sanctuary, Madhya Pradesh ... 719
Plate III. One of the *maidans* in Kanha Sanctuary, Madhya Pradesh ... Chital stag (*Axis axis*) in *sal* forest, Kanha Sanctuary ... 722
Plate IV. Barasinga or Swamp Deer. Master stag and hinds. Kanha Sanctuary, Madhya Pradesh ... Barasinga Stags. Kanha Sanctuary ... 723
Plate V. A herd of Gaur (*Bibos gaurus*). Bandipur Wild Life Sanctuary, Mysore ... Young bull Gaur, Bandipur Sanctuary, Mysore ... 726
Plate VI. Forest Rest House, Dhikala. Hailey National Park, Uttar Pradesh ... View across Ramganga River from above rest house. Himalayan foothills in distance ... 727

The Birds of Gujarat. Part II.

Plate I. Deciduous forest, Dediapada, Rajpipla (late March). Favourite haunt of the Spotted Tree Creeper (*Salpornis spilonotus*) ... Whitewinged Black Tit (*Parus nuchalis*) at nest-hole in babul trunk. Chaduva, Kutch ... 785

Comparative Observations on the Placenta and Foetal Nutrition in Elasmobranchs and Mammals.

Plate I. Foetal placentae in Bombay elasmobranchs .. 832
Plate II. Appendicula in Bombay elasmobranchs .. 833

Nyctibatrachus humayuni, a new Frog from the Western Ghats, Bombay.

Plate. *Nyctibatrachus humayuni*, new species ... 852

PAGE

Ixodes kerri, a new Species of Tick from a Flying Squirrel from southern India (Acarina : Ixodidae).

Plate I. *Ixodes kerri*, new species. Female ... 860
Plate II. *Ixodes kerri*, new species. Male ... 861

A new Species of *Chlorophytum* from Salsette Island.

Plate. *Chlorophytum borivilianum* sp. nov. ... 897

The Brow-antlered Deer (*Cervus eldi* MacClelland).

Plate I. Brow-antlered Deer stag. Vincennes Zoo, Paris ...
Stag with four of the five hinds, in Vincennes Zoo, Paris } 918
Plate II. Brow-antlered Deer (*Cervus eldi thamin*) in Rangoon Zoo. 919

Notes on *Thrips palmi* Karny, attacking *Sesamum indicum*.

Plate. Fig. 1. A. — Attacked sesamum plant showing fruits with dark pigment; ...
a. — *Thrips palmi*, female ... } 952

On the Occurrence of *Marsilea aegyptiaca* Willd. in Jodhpur, Rajasthan (India).

Plate. *Marsilea aegyptiaca* Willd. from Jodhpur, Rajasthan ... 955

Alternanthera polygonoides R. Br., var. *erecta* Mart. — A new record for Bombay State.

Plate. ... 957

Abnormalities in the 'Ear' of *Zea mays* L.

Plate. ... 958

INDEX TO ILLUSTRATIONS

VOLUME 52

Nos. 1, 2, 3, and 4

PAGE

Achnanthes sp.
  Plate II. Fig. 10 ... 117
Alternanthera polygonoides var. *erecta*
  Plate 957
Amyciaea forticeps
  Figs. 1 and 2 251
  Fig. 3 252
  Fig. 4 253
  Fig. 5 258
Anthus novaeseelandiae malayensis
  Plate II 15
Antilope cervicapra
  Photo 920
Antrocephalus galleriae
  Text-fig. 948
Arabia, Comments on Biogeography with particular reference to Birds
  Map 242
  Map 243
Araneus bilunifer
  Text-fig. 883
Ardea cinerea
  Photo 935
Areca catechu
  Fig. Abnormal Fruit ... 224
Argiope pulchella
  Fig. 9 880
Arthraxon meeboldii
  Plate 482
———*purandharensis*
  Plate 482
Axis axis
  Plate III 722
Barbus stigma
  Graph 627
Bibos gaurus
  Plate V 726
Biddulphia sp.
  Plate II, Figs. 13-15 ... 117

PAGE

Birds of Gujarat, The
  Map 374
  Plate I ... between 374/5
  Plate II 375
  Plate III 376
  Plate IV 377
  Plate V 388
Birds seen above the tree-line in Tehri-Garhwal, in Central Himalayas
  Rudugaira Valley ... 610
  Diagram of altitude zones, 611
  Plate I 612
  Plate II 613
Bird Trap
  Photo 937
Bitterns in a Penang Marsh, Two
  Plate I 687
  Plate II 688
  Plate III 689
  Plate IV 690
Boswellia serrata
  Showing attacks by *Coptotermes heimi* and *Odontotermes redemanni*
  Fig. 1 464
  Plate I 464
Buffalo bull Wild
  Plate I 718
Cervus eldi
  Plate I 918
  Plate II 919
———*unicolor*
  Photo 588
Cetorhinus maximus
  Plate I 330
  Plate II 331
Chaetoceros laevis
  Plate I, Fig. 5 ... 116
Chela bacaila
  Graph 627

PAGE
Chela gora
Graph 626
Chlorophytum borivilianum
Plate 897
Citrus aurantium
Fig. Bi-foliate leaf ... 221
Commelina suffruticosa
Plate II 663
Corymorpha sp.
Fig. 220
Crab Fishery in the sea off Ennur, near Madras
Text-fig. 917
Crematogaster dohrni rogenhoferi
Plate I 356
Text-Figure 357
Plate II 360
——— ———sp.
Plate III 361
Cyclosa confraga
Figs. 11 and 12... ... 882
Cymbopogon caesius
Fig. 6 152
———*citratus*
Fig. 4 152
———*clandestinus*
Fig. 9 158
———*coloratus*
Fig. 23 177
———*distans*
Fig. 21 166
———*exsertus*
Fig. 18 166
———*flexuosus*
Fig. 16 166
———*gidarba*
Fig. 13 158
———*hookeri*
Fig. 11 158
———*jwarancusa*
Fig. 25 177
———*khasianus*
Fig. 20 166
———*martinii*
Fig. 5 152
———*microtheca*
Fig. 14 158
———*nardus*
Fig. 2 152

PAGE
Cymbopogon nardus var. *confertiflorus*
Fig. 1 152
Cymbopogon nervatus
Fig. 10 158
———*osmastonii*
Fig. 8 158
———*parkeri*
Fig. 27 177
———*pendulus*
Fig. 17 166
———*polyneuros*
Fig. 7 152
———*schoenanthus*
Fig. 26 177
———*stracheyi*
Fig. 15 158
———*thwaitesii*
Fig. 22 177
———*tibeticus*
Fig. 12 158
———*travancorensis*
Fig. 24 177
———*virgatus*
Fig. 19 166
———*winterianus*
Fig. 3 152
Cyrtophora ciccatrosa
Fig. 10 881
Diatoms, of the Chilka Lake for the years 1950 and 1951, Periodicity of the Plankton
Map 112
Map 120
Elasmobranchs
Plate I 832
Plate II 833
Elephant (*makna*), Wild
Plate I 718
Elephants, Growth-gradients of Indian
Fig. 1 843
Fig. 2 845
Figs. 3 and 4 846
Fig. 5 847
Figs. 6 and 7 848
Figs. 8 and 9 849
Figs. 10 and 11... ... 850
Ephedra
Photo 10
Eucta javana
Fig. 2 877

PAGE

Fish Geography, Tectonic History of India and its bearing on
  Text-fig. 1 693
  Text-fig. 2 695
  Text-fig. 3 696
  Text-fig. 4 698
  Text-fig. 5 699
  Text-fig. 6 699
  Text-fig. 7 700
Flora of the West Coast of South India, Back-water
  Map 70
Gasteracantha arcuata
  Fig. 15 884
——— *brevispina*
  Fig. 16 884
——— *remifera*
  Fig. 14 884
Grammatophora sp.
  Plate II, Fig. 9 ... 117
Gyrosigma sp.
  Plate II, Figs. 11-12 ... 117
Hailey National Park, Uttar Pradesh
  Plate VI 727
Hare, Oriyas hunting
  Sketch 5 293
Hemiaulus sp.
  Plate II, Figs. 7-8 ... 117
Ho trap for wild pig
  Sketch 6 296
Inglis, Charles M.
  Plate 566
Ipomoea triloba
  Plate I 662
Ixodes kerri
  Plate I 860
  Plate II 861
Kanha Sanctuary
  Plate III 722
Kruger National Park, South Africa
  Plate I 2
  Plate II ... between 2 & 3
  Plate III ... „ 2 & 3
  Plate IV ... „ 2 & 3
  Plate V 4
  Plate VI 5
Leptocoma jugularis microleuca
  Plate III ... 16

PAGE

Leptocoma jugularis microleuca
  Plate IV 17
  Plate V 18
Leucauge bengalensis
  Fig. 5 (b) 877
——— *culta*
  Fig. 5 (a) 877
——— *decorata*
  Fig. 3 & 4 877
Marsilea aegyptiaca
  Plate 955
Melosira sp. (?)
  Plate I, Fig. 6 116
Murdannia scapiflorum
  Plate I 138
  Plate II 140
Nephila maculata
  Figs. 6 & 7 878
——— *malabarensis*
  Fig. 8 878
Nyctibatrachus humayuni
  Plate 852
Odontotermes parvidens
  Plate I 460
Orthotomus sutorius maculicollis
  Plate I 14
Palamnaeus bengalensis
  Fig. 1 536
  Fig. 2 537
Panther Trap
  Sketch 2 289
Paratelphusa guerini
  Text-fig. 941
Parus nuchalis
  Plate I 785
Pilani and its Neighbourhood, Vegetation of
  Map 484
Pinctada pinctada
  Fig. I 126
  Fig. II 127
  Fig. III 128
  Fig. IV 132
  Fig. V 133
Rana breviceps
  Fig. 1. Right foot ... 622
Rhizosolenia bergonii
  Plate I, Figs. 2-3 ... 116
——— *delicatula*
  Plate I, Fig. 4 116

PAGE

Rohtee cotio
  Graph 627
Rohtee vigorsii
  Graph 627
Rucervus duvaucelli
  Plate II 719
  Plate IV 723
Salpornis spilonotus
  Plate 1. Favourite haunt 785
Sesamum indicum
  Plate. Fig. 1A ... 952
  Text-fig. 2. 952
Snowman's Scalp, Abominable
  Photo 595
Solanum melongena
  Fig. 226
Spring Trap used for wild cats, foxes, hares and peafowl
  Sketch 3 290
Tatera indica cuvieri
  Histogram showing seasonal Food Constituents of 322
Tetragnatha gracilis
  Fig. 1 875
Thrips palmi
  Plate, Fig. 1 a. 952

PAGE

Tiger Trap
  Sketch 1 287
Tilapia mossambica
  Fig. 1 350
  Figs. 2, 3 and 4 ... 351
  Figs. 5 and 6 352
Uca annulipes
  Plate I, Figs. 2 & 3 ... 702
  Plate IV, Fig. 10 ... 705
  Plate V, Fig. 11 ... 710
——*marionis nitidus*
  Plate II, Figs. 4-6 ... 703
  Plate III, Fig. 7 ... 704
  Plate IV, Fig. 9 ... 705
  Plate V, Fig. 13 ... 710
  Fig. 12 710
Uca sp.
  Plate III, Fig. 8 ... 704
Urang Rat Trap
  Sketch 4 291
Wild Life Preservation and Sanctuaries in the Union of Burma
  Map 264
Yungipicus nanus semicoronatus
  Text-figure 60
Zea mays
  Plate 958

INDEX OF SPECIES

PAGE
Abies ... 31, 315, 317
—— fargesii ... 315
—— webbiana ... 886
Abisara echerius prunosa ... 369
—— —— suffusa ... 820
Abrus precatorius ... 90, 524
Abutilon ... 488
—— indicum ... 492
Acacia ... 375, 487, 754
—— arabica ... 185, 375, 497
—— auriculiformis ... 645, 646
—— catechu... 376, 743
—— concinna *var.* fulva ... 664
—— farnesiana ... 497
—— leucocephalia ... 185
—— modesta ... 497
—— senegal ... 488, 497
Acalypha brachystachya ... 110
Acanthias ... 833
Acanthocephalus kadamba (?) ... 375
Acantholipes circumdata ... 951
—— circumflueta ... 951
Acanthus ... 80
—— ilicifolius ... 69, 80, 664
—— maderaspatanus ... 505
Accipiter badius dussumieri ... 394
—— nisus nisosimilis ... 394
—— *sp.* ... 930
—— virgatus *ssp.* ... 394
Acer ... 313, 314, 316
—— campbelli (?) ... 307
—— sikkimensis ... 314
—— wardii ... 314
Acheata ... 545
Acheta ... 546
—— bimaculata ... 544
Achnanthes ... 116
Achyranthes ... 488
—— aspera ... 507
Aconitum ... 90
—— napellus ... 90
Acraea violae ... 817
Acridotheres ginginianus ... 796
—— tristis ... 55, 207, 619

PAGE
Acridotheres ginginianus tristis 796, 797
Acrocephalus agricola agricola ... 762
—— —— dumetorum ... 762
—— —— stentoreus ... 450
—— —— —— brunnescens 762
Actinastrum ... 349
Actitis hypoleucos ... 397
Adhatoda vasica ... 505
Adina cordifolia ... 376
Aecanthus ... 557
Aegiceras ... 69, 78
—— corniculatum ... 69, 78
Aegithaliscus concinnus ... 26
—— —— iredalei ... 888
Aegithina nigrolutea ... 742, 743
—— tiphia humei ... 742, 743
Aegle marmelos ... 375
Aegypius monachus ... 399
Aeromachus dubius ... 373
Aerua javanica ... 507
—— lanata ... 507
—— tomentosa ... 507
Aesculus assamica ... 307
—— punduana (?) ... 307
Aethopyga ignicauda ignicauda ... 894
—— nepalensis nepalensis ... 894
—— nipalensis ... 57
—— saturata ... 58
—— siparaja vigorsi ... 377, 788
Aetobatus ... 833
Agapetes ... 313
Agave vera-cruz ... 510
Ageratum conyzoides ... 108, 499
Agrobates ... 758
—— galactodes familiaris ... 377
Agyneia bacciformis ... 659
Alaemon alaudipes doriae ... 456
Alangium lamarckii ... 789
Alauda gulgula ... 458
—— —— gulgula ... 458
—— —— inconspicua ... 458
—— —— punjaubi ... 458
Albizzia ... 312
—— lebbeck ... 497, 646

Page
Albizzia procera ... 21, 376
——— stipulata ... 21
Albunea ... 947
Alcedo atthis bengalensis ... 444
——— ——— taprobana ... 444
Alcemerops athertoni ... 377
Alcimandra cathcartii ... 307
Alcippe ... 747
——— nepalensis ... 30
——— poioicephala brucei ... 755
Alcurus striatus ... 35
Alectoris ... 246
——— graeca ... 615
——— melanocephala ... 246
Alhagi camelorum ... 496
——— maurorum ... 496, 772
Allium cepa ... 510
——— rubellum ... 111
——— sativum ... 510
Alnus nepalensis ... 312
Alstonia venenatum ... 664
Alternanthera ... 957
Alternanthera echinata ... 665
——— polygonoides *var.* erecta 957
——— ——— pungens ... 507 659
——— sessilis ... 507, 957
Althea rosea ... 491
Alticola roylei ... 615
Altinga excelsa ... 307, 312
Alysicarpus monilifer ... 496
Amarantus blitum ... 507
——— paniculatus ... 507
——— polygamous ... 664
——— spinosus ... 507
——— viridis ... 507
Amaurornis akool akool ... 410
——— phoenicurus *spp.* ... 411
Ambassis ranga ... 631
Amblypodia ... 803, 826
——— adatha regia ... 826
——— adriana ... 826
——— ? agesilaus ... 825
——— amantes amantes 372, 826
——— areste arestina ... 827
——— centaurus pirithous ... 826
Ammania dentelloides ... 664
——— floribunda ... 938
——— rotala ... 665
Ammomanes ... 246
——— phoenicurus phoenicurus ... 456

Page
Amorphophallus sylvaticus ... 90
Amphilophis odorata ... 659
Ampittia diascorides ... 373
Amphora ... 349, 625
Amsacta lineola ... 649
Amusurgus ... 553
——— fulvus ... 553
——— oedemeroides ... 553
——— speculifer ... 553
Amyciaea ... 252, 253, 255, 258, 259, 260, 261, 262, 263
Amyciaea forticeps 249, 250, 251, 253, 262
Anabaena ... 349, 629
——— flosaque ... 629
Anagallis arvensis *var.* coerulea ... 500
Anamirta cocculus ... 91
——— paniculata ... 91
Anapheis mesentina ... 368
Anaptygus *sp.* ... 615
Anas acuta acuta ... 390
——— angustirostris ... 389
——— crecca crecca ... 390
——— falcata ... 390
——— penelope ... 390
——— platyrhyncha ... 390
——— poecilorhyncha poecilorhyncha 390
——— querquedula ... 390
——— strepera ... 390
——— streperus ... 931
Anastomus oscitans ... 385
Anaxipha ... 554
——— henryi ... 555
——— longipennis ... 554
——— pubescens ... 554
Ancylolomia *sp.* ... 649
Andropogon ... 512
——— annulatus ... 511
——— carocpsis ... 511
——— clandestinus ... 149, 150
——— coloratus ... 172, 173
——— contortus ... 511
——— (Cymb.) caesius elatior ... 174
——— distans ... 169, 177
——— flexuosus ... 161, 162
——— gidarba ... 156, 157, 160
——— himalayensis ... 178
——— hookeri ... 153
——— jwarancusa ... 178, 179
——— ——— *subsp.* laniger ... 180

PAGE
Andropogon laniger ... 180, 182, 183
———— microtheca ... 157, 159
———— nardus ... 166, 174
———— ——— *var.*
coloratus ... 172
———— ——— *subsp.*
flexuosus ... 161
———— ——— *subsp.*
glomeratus ... 172
———— ——— *var.*
khasianus 168, 169
———— ——— *subsp.*
marginatus *var.*
exsertus ... 165
———— ——— *var.*
microstachys 162, 163
———— ——— *var.*
stracheyi 159, 160
———— pendulus 163
———— schoenanthus ... 180, 183
———— ———— *var.*
nervatus ... 150
———— sorghum 185, 323
———— thwaitesii 171
Androsace 310
Aneilema 137, 138
——— dimorphum 658
——— giganteum 658
——— herbaceum 658
——— lanuginosum 658
——— malabarica 658
——— nudiflorum 658
——— ochraceum 658
——— paniculatum 658
——— pauciflorum 658
——— scapiflorum ... 137, 138, 658
——— sinicum 658
——— spiratum 658
——— tuberosa 138
——— tuberosum 138
——— vaginatum 658
——— versicolor 658
Anemone obtusiloba 91
Anhinga melanogaster 381
Aniseia 79
——— uniflora 79
Anisephyra ocularis 649
Anisochilus carnosus 534
——— eriocephalus 534
Anisomeles *sp.* 185
Ankistrodesmus 349, 625, 629

PAGE
Annona reticulata 91
——— squamosa 91
Anogeissus latifolia 376
——— pendula 488, 497
Anona squamosa 489
Anormogoniphus heteropterus ... 567
Anotis wightiana 665
Anser albifrons [albifrons] 388
——— anser [rubrirostris] 388
——— indicus 388, 931
Antarchaea munsueta 649
Anthericum 898
Anthropoides virgo 410
Anthus campestris griseus 777
——— cervinus 777
——— ——— berezowskii 575
——— hodgsoni 56
——— ——— hodgsoni 775
——— pelops 894
——— novaeseelandiae malayensis ... 15
——— richardi godlewskii 776
——— ——— rufulus 776
——— ——— waitei 777
——— roseatus ... 57, 575, 614, 777
——— rufogularis 777
——— sordidus decaptus 776
——— ——— jerdoni 776
——— spinoletta 778
——— striolata godlewskii 894
——— trivialis haringtoni 776
——— ——— trivialis ... 775, 776
Anticarsia irrorata 649
Antigastra catalaunalis 649
Antilope cervicapra 867, 870
Antrocephalus 950
Antrocephalus galleriae ... 948, 950
——— renalis 950
Anuraea 349
Anurogryllus tenellus 543
Aphanocapsa 625, 629
Apharitis lilacinus 372
Aphodius carinulatus 649
——— reichei 951
Apis indica 950
Aponogeton crispum 664
——— monostachyum 664
Aporia agathon ariaca 808
Appias albina 367
——— indra indra 809
——— libythea 366
——— ——— libythea 367

PAGE
Aprionodon acutidens 832
Apus 641, 643, 946
Apus affinis affinis 442
——— asiaticus 641
——— australiensis 641, 643, 644
——— cancriformis 641, 642, 644
——— mavliensis 644
——— melba *ssp.* 442
——— orientalis 641, 642, 644, 945, 946
Aquila clanga 398
——— heliaca 398
——— ——— heliaca 397
——— nipalensis 67, 398
——— ——— nipalensis 398
——— rapax 396, 398
——— ——— vindhiana 392, 397
Arachis hypogaea 323, 375
——— hypogea 185
Arachnomimus 558
Arachnomimus annulicornis 558
——— ——— bicolor 558
——— ——— nietneri 558
Arachnopsis 558
Arachnothera magna 58
Araneus 874, 879, 880, 881, 883
Araneus (Epeira) 883
Araucaria cunninghami 512
Arborophila torqueola 68
Ardea cinerea 935
——— ——— [rectirostris] 381
——— purpurea [manilensis] 381
Ardeola 383
Ardeola grayii 382, 396, 707
Ardisia 78
Ardisia littoralis 78
Areca catechu 92, 224
Arenaria 360
Arenaria interpres interpres 419
Argemone 488
Argemone mexicana 92 489
Argiope 874, 879, 880, 884
Argiope catenulata 880
——— pulchella 880
Argya caudata 403, 433
Argynnis hyperbius hyperbius ... 819
Argyroepeira 877
Ariamnes similans 876
Aristida hystrix 511
Aristolochia 81
Aristolochia bracteata 508
——— indica 81

PAGE
Artamus fuscus 48
Artemisia scoparia 500
Arthraxon 481
Arthraxon inermis 481
——— jubatus 481
——— lancifolius 481
——— meeboldii 481, 483
——— purandharensis ... 481, 483
——— quartinianus 481
——— serrulatus 481
Arthrospira 7
Aruncus sylvester 93
Arundinaria 309, 315
Asio flammeus flammeus 430
——— otus 440
Asparagus adscendens 510
Aspermytes khandalensis 859
Asphanchna 625
Asphodelus tenuifolius ... 111, 510
Aspidopterys *sp.*... 312
Assystasia gangetica 664
——— macrocarpa 664
Astacus fluviatilis 714
Asterionella japonica 116, 118, 119, 120, 122
Astilbe 315
Astur badius 67, 404, 437, 800
Astycus pythias lanka 373
Asystasia 80
Asystasia gangetica 80, 659
Atella phalanta 370, 819
Athene brama 297, 929
——— ——— brama 439, 895
——— ——— indica 439
——— noctua 929
Atherigona *sp.* (*possibly* oryzae) ... 650
Atropa acuminata 93
——— belladonna 93
Atrophaneura aristolochiae aristolochiae 804
——— latreillei latreillei ... 804
——— priapus egertoni ... 804
Atylosia barbata 665
Aularches 216, 935
Aulocera brahminus brahminus ... 810
Avena 511
Avicennia 81
Avicennia alba 69
——— marina 69
——— officinalis 81, 361
——— *sp.* 361
Axis axis 867, 870
——— porcinus 867

Page
Aythya ferina ... 391
—— fuligula ... 391
—— marila marila ... 391
—— nyroca ... 391
Azadirachta indica ... 93, 494, 518
Bacillaris paradoxa ... 116, 118, 119, 123
Bacteriastrum hyalinum ... 113, 118
Badamia exclamationis ... 372
Balaenoptera *sp.* ... 585
Balanites aegyptiaca ... 493
—— roxburghii ... 493
Baleria prionities ... 664
Baliospermum axillare ... 94
—— montanum ... 94
Balsamodendron ... 488
Balsamodendron mukul ... 743, 785, 793
Bambusa arundinacea ... 376
Baoris kumara kumara ... 373
—— zelleri cinnara ... 373
Barbus carnaticus ... 350
—— sarana ... 350, 634
—— stigma ... 350, 626, 627, 628, 631
Barringtonia ... 76
Barringtonia acutangula ... 94
—— asiatica ... 94
—— racemosa ... 76, 95
—— speciosa ... 94
Bassia ... 439
Bassia latifolia ... 375, 376
Bayadera longicauda ... 567
Begonia ... 309, 314
Belone stronglylura ... 214
—— strongylurus ... 214
Bergenia ... 310
Bergia ammanioides ... 664
—— odorata ... 491
Berberis ... 310, 314, 887
Beta vulgaris ... 508
Betula *sp.* ... 314
Betula alnoides ... 21
—— utilis ... 857
Biddulphia mobiliensis ... 116, 118, 119, 123
—— sinensis ... 116, 118, 119, 123
—— *sp.* ... 117, 119
Biblia ilythea ... 370
Bibos gaurus ... 870
Biston betularia ... 215, 953
Blainvillea latifolia ... 500
—— rhomboidea ... 500
Blepharis boerhaaviaefolia ... 505
—— mollugenifolia ... 664

Page
Blythipicus pyrrhotis ... 60
Boehmeria platyphylla ... 110
Boerhaavia diffusa ... 487, 506
—— repanda ... 506
—— repens ... 506
Boerhavia verticillata ... 11
Bolboceras quadridens ... 951
Bombax ... 788
Bombax malabaricum ... 376
Borassus flabellifer ... 375, 442
Borreria ... 77
Borreria hispida ... 77
Bos gaurus ... 653
Boselaphus tragocamellus ... 867
Bosmina ... 349
Bostra *sp.* ... 649
Boswellia ... 488
Boswellia serrata ... 463, 466
Botaurus stellaris [stellaris] ... 385
Bougainvillea spectablis ... 509
Brachiaria distachya ... 185, 322
Brachionus ... 349, 625, 629
Brachydanio rerio ... 350, 361
Brachypternus bengalensis ... 61
Brachytrypes orientalis ... 542
Branchellion ... 473, 474, 479
Branchellion pinnatus ... 473, 475
Branchiobdella ... 474
Branchiobdella menziesi ... 473
Brassica campestris *var.* rapa ... 490
—— cernua ... 490
—— napus ... 490
—— oleracea ... 490
Bruguiera ... 76
Bruguiera conjugata ... 76
—— cylindrica ... 76
Bubalus bubalis ... 202, 870
Bubo bubo bengalensis ... 436
—— coromandus coromandus ... 437
—— zeylonensis hardwickii ... 437
—— —— leschenault ... 437, 438
Bubulcus ... 383
Bubulcus ibis ... 707
—— coromandus ... 382
Bucklandia populnea ... 307, 312, 313
Budorcas taxicolor ... 598
Buettneria jakiana ... 665
Bulbostylis ... 82
Bulbostylis puberula ... 82
Bungarus caeruleus ... 939
Bupleurum tenue ... 107

PAGE

Burhinus oedicnemus 299, 423
——— ——— indicus ... 423
——— ——— saharae ... 423
Butastur teesa 395
Butea 375, 754, 788
Butea frondosa 95, 375, 495
——— monosperma 95, 495, 646
Buteo lagopus 930
——— rufinus 394, 929
Buthus 537, 538
Buthus *sp.* 940
Butorides striatus [javanicus] ... 382
Cacomantis merulinus 64
——— sonnerati sonnerati ... 434
Cajanus cajan 459
——— indicus 185, 323, 459
Calaenorrhinus ambareesa 372
——— leucocera leucocera 372
Calamintha umbrosa 664
Calamus 313
Calandrella acutirostris 929
——— brachydactyla longipennis 377
——— cinerea longipennis ... 456
——— raytal 8
——— ——— adamsi 8, 457
——— krishnakumarsinhji ... 8, 457
——— raytal 8
Calceolaria mexicana 109
Calendula officinalis 500
Calidris alpinus alpinus 421
——— minutus minutus 420
——— temminckii 421
——— testaceus 421
Calligonum 12
Calligonum polygonoides ... 10, 12, 512
Calliope pectoralis 928
——— tschebaiewi 928
Calophyllum 71
Calophyllum decipiens 71
——— ——— inophyllum 71
Calotes 398
Calotropis 216, 488, 788
Calotropis gigantea 185, 501
Calotropis procera 487, 501
Caltha 315
Camallanus *sp.* 945
Camalus sweetei 945
Camellia 308, 309
Camellia sinensis 309
——— thea 21
Canavalia ensiformis 95, 49

Canavalia ensiformis *var.* virosa ... 95
——— virosa 95
Canna indica 510
Cannabis sativa 520
Canscora diffusa 502
Canthelea lateritalis 649
Canthium *sp.* 185
Capella gallinago gallinago 420
——— minima 420
——— stenura 420
capensis, (Ramphalcyon capensis) ... 575
Capparis 402, 424, 487, 745, 765, 772, 773, 788, 792
Capparis aphylla 375, 487, 488, 490, 496, 512, 742, 744, 755, 757, 758, 792, 793
——— spinosa 490
——— *sp.* 185
Caprimulgus asiaticus asiaticus ... 441
——— europaeus unwini 377, 440
——— indicus indicus 440
——— mahrattensis 441
——— monticolus monticolus 441, 603
Caprona agama pelias 373
——— ransonetti ransonetti ... 373
Capsella bursa-pastoris 490
Capsicum 504
Caragana 928, 929
Carcharinus dussumieri 835
——— limbatus 832
——— melanopterus 832
——— menisorrah 832
——— sorrah 832
——— temminckii 832
Carcinobdella 474
Cardamine oxycarpa 106
Cardina nilotica 349
Cardiodactylus 560
Cardiodactylus praecipuus 560
Cardiophorus formosus 649
——— notatus 951
Cardiospermum halicacabum ... 494
Carduelis caniceps 928
Carica papaya 96
Carissa carandas 501
Carpodacus erythrinus roseatus ... 893
——— pulcherrimus pulcherrimus 893
——— rhodochrous 893
——— rhodopeplus 893
——— rubicilla 928
——— *sp.* 613

PAGE

Carpodacus thura thura 893

Caryopteris wallichiana 109

Casarca ferruginea 931

Cassia auriculata 185, 496

——— fistula 496

——— occidentalis 496

——— sophora 496

Castalius deleta decidea 371

——— rosimon rosimon 371

Castanopsis 312, 313

Catachrysops strabo 371

Catla catla 350, 629

Catopsilia crocale 367

——— florella 215

——— ——— gnoma 810

——— nerissa 366

——— pomona 366, 367

——— ——— *f.* catilla 367

——— pyranthe 367

——— ——— pyranthe 810

Caylusea 245

Cedrela toona 21

Celama taenista 649

Celastrus senegalensis 487, 494

Celosia argentea 506

——— cristata 506

Celsia coromandelina 664

Cenchrus 488, 511

Cenchrus biflorus 511

——— ciliaris 511

——— setigerus 511

Centella 77

Centella asiatica 77

Centratherum anthelminticum ... 96

Centrophorus 883

Centropus sinensis parroti 435

Cephalandra indica 498

Cephalotaxus 311, 312

Cephalotaxus manii 311

Cepora nadina remba 809

——— merossa phrynne ... 368, 809

Ceratophylum demersum 664

Ceratium 625

Cerbera 78

Cerbera manghas 78, 96

——— odollam 96

Cerchneis tinnunculus 67, 929

Cercomela fusca 774

Ceriodaphnia 349

Ceriops 69, 75

Ceriops candolleana 75

PAGE

Ceriops roxburghiana 361

Cerithium 6

Cermanthodium 310

Ceropegia bulbosa 502

Certhia 783

Certhia familiaris mandellii 890

Cervulus aureus 860

——— ——— (= Muntiacus muntjak aureus) 860

Cervus eldi eldi 917, 918

——— ——— siamensis 918, 919

——— ——— thamin 918, 919

——— unicolor 588

Ceryle rudis leucomelanura 443

Cestrum nocturnum 109

Cetorhinus 331, 332

Cethosia *spp.* 953

Chaetoceros affinis ... 116, 119, 122

——— compressus ... 116, 122

——— curvisetus ... 116, 118, 119, 122

——— eibenii 113, 119, 122

——— laevis 116, 118, 119

——— lorenzianus 113, 116, 117, 118, 119, 122

——— peruvianus 113, 118 119, 122

——— subtilis ... ... 116, 117' 119

Chaetophora 629

Chaetoprocta odata 825

Chaetornis striatus 761

Chaimarrhornis leucocephala 613, 891

——— ——— leucocephalus ... 38

Chalcophaps indica 927

——— ——— indica 431

Chanos chanos 350, 629

Chaoborus *sp.* 649

Chaptia aenea 50

Chara zeylanica 349

Charadrius alexandrinus 416

——— ——— alexandrinus 415

——— ——— seebohmi ... 416

——— dubius 415, 416

——— ——— curonicus 415

——— ——— jerdoni 415

——— leschenaulti leschenaulti ... 415

——— mongolus atrifrons 416

Charana cepheis... 828

——— jalindra indra 828

——— mandarinus 828

Charaxes fabius fabius 369

——— polyxima imna 369

Cheiranthus cheiri 97

PAGE
Chelone mydas ... 474, 475
Chenopodium album ... 508
—— ambrosioides ... 97
—— murale ... 508
Chela bacaila ... 626, 627, 628
—— gora ... 626, 627, 628
Chelidorhynx hypoxanthum ... 45, 892
Chettusia gregaria ... 414
—— leucura ... 413
Chibia hottentotta ... 51
Chilades laius laius ... 371
Chilasa clytia clytia ... 366
—— —— dissimilis ... 366
Chilo zonellus ... 649
Chilomonas ... 629
Chirita ... 309
Chironomus (?) ... 388
Chlamydomonas ... 349, 629
Chlamydotis undulata macqueeni ... 412
Chliaria othona ... 829
Chlidonias hybrida indica ... 425
Chlorella ... 349, 625
Chloris virgata ... 511
Chlorophytum ... 897, 898
Chlorophytum attenuatum ... 897
—— borivilianum ... 898
—— malabaricum ... 897
—— tuberosum ... 897, 898
Chloropsis aurifrons frontalis ... 743
—— cochinchinensis jerdoni ... 743
—— hardwickii ... 33
Chonemorpha pedicellata ... 191
Choriotis nigriceps ... 411, 865
Chroococcus ... 625
Chrozophora plicata ... 97
—— rottleri ... 97
—— tinctoria ... 97
Chrysanthemum *sp.* ... 500
Chrysocolaptes festivus festivus ... 453
—— guttacristatus ... 60, 377
—— lucidus ... 451
—— —— chersonesus ... 454
Chrysomma ... 458
Chrysomma sinense ... 763
—— —— hypoleuca. ... 752, 753
—— —— sinense ... 753
Chrysophlegma flavinucha ... 58
Ciconia ciconia *ssp.* ... 385
—— —— ciconia ... 377
—— episcopa episcopa ... 385
—— nigra ... 385

PAGE
Cicer arietinum ... 185, 323, 496
Cinclus cinclus ... 613, 895, 927
—— pallasii ... 36, 613
Cinnyris asiatica ... 619
—— —— asiatica ... 788
Cimicifuga ... 315
Circaëtus gallicus gallicus ... 401
Circus aeruginosus aeruginosus ... 401
—— macrourus ... 400
—— pygargus ... 400
Cirrepedesmus mongolus ... 931
Cirrhina cirrhosa ... 350
—— mrigala ... 350, 629
—— reba ... 350, 629
Cissa chinensis ... 25
Cistanche tubulosa ... 504
Cisticola ... 14, 15, 763, 765
Cisticola juncidis cursitans ... 767
Citrullus vulgaris ... 498
Citrus ... 222
Citrus aurantium ... 222, 493
—— medica ... 493
Clamator coromandus ... 65, 211
—— jacobinus ... 755
—— —— [pica] ... 433
Clematis ... 312
Cleome felina ... 97
—— icosandra ... 93
—— vicosa ... 98, 487, 490
Clerodendron ... 80
Clerodendron inerme ... 73, 80
—— phlomidis ... 505
Clethra delavayi (?) ... 315
Clitoria ternatea ... 495
Closterium ... 349, 625, 629
Cnaphalocrocis medinalis ... 649
Coccinia ... 488
Coccinia indica ... 498
Cocconeis placentula ... 116, 117, 118, 119, 123
Cocculus villosus ... 11
Coelastrum ... 349, 625
Coiblemmus ... 547
—— compactus ... 547
Coladenia dan dan ... 373
—— indrana indrana ... 373
Colchicum autumnale ... 98
—— luteum ... 98
Colias alpherakii chitralensis ... 811
—— electo fieldii ... 812

PAGE
Colias wiskotti wiskotti 811
Colotis amata amata 368
—— etrida 368
—— faustia fulvia 368
—— modesta modesta 368
Colpodes ruficeps 649
Colquhounia 894
Columba leuconota 615
—— —— leuconota ... 895
—— livia 297
—— —— intermedia 429
—— —— neglecta 429
—— —— *ssp.* 428
—— rupestris 930
Commelina 488
Commelina benghalensis 510
—— nudiflora 510, 658
—— obliqua 510, 662
—— scapiflora 138
—— suffruticosa 667
Convolvulus arvensis 502
—— dentatus 661
—— microphyllus *var.* boisseri 659, 665
—— pluricaulis 502
Conyza stricta 108
Cophogryllus 547
—— martini 547
Copsychus macrourus malabaricus ... 769
—— saularis 39, 616
—— —— saularis 769
Coptis teeta 319
Coptotermes 466
Coptotermes heimi 463, 465, 466
Coracias benghalensis 208
—— —— benghalensis ... 447
—— garrula semenowi ... 377, 440
Coracina melanoptera sykesi 749
—— novaehollandiae macei ... 740
Corchorus acutangulus 492
—— aestuans 492
—— tridens 492
—— trilocularis 492
Cordia myxa 502
—— rothii 502
Coriaria nepalensis 98
—— myrtifolia 98
Coriandrum sativum 499
Corvus corax laurenci 802
—— —— tibetanus 927
—— macrorhynchos 24

PAGE
Corvus macrorhynchos culminatus ... 802
—— —— intermedius. 612, 887
—— rhipidurus 247
—— splendens ... 24, 297, 434, 707, 802
—— —— splendens 801
—— —— zugmeyeri 802
Coscinodiscus centralis ... 113, 116, 117, 118, 119, 122
Cosmarium 349
Cosmophila flava 649
Cosmos bipinnatus 500
Cotoneaster 310, 314, 886
Coturnix 398
Coturnix coromandelica 406
—— coromandelicus 299
—— coturnix 299
—— —— coturnix 406
Crataeva religiosa 490
Cremanthodium 310
Cremastus *spp.* 649
Crematogaster auberti 356
—— contenta 356
—— dohrni 363
—— —— artifex ... 356, 357, 360, 363
—— rogenhoferi. 354, 355, 356, 357, 359, 360, 361, 362, 363, 364
—— ebeninus 355
—— physothorax ... 355, 356
—— rongenhoferi 355
—— rothneyi 356
—— soror 356
—— *sp.* ... 355, 356, 361, 362, 363
Crinum amoenum 665
Criotettix grandis 950
Crocodilus palustris 213, 865, 938
—— porosus 213, 937
Crocopus phoenicopterus 868
Crotalaria 21, 73
Crotalaria burhia 487, 495
—— medicaginea 495
—— —— *var.* neglecta. 664
—— quinquefolia 664
—— striata 73
—— verrucosa 73
Croton oblongifolius 98
—— sparsiflorous 664
—— tiglium 94, 98, 99

PAGE
Crucigenia 625, 629
Crypsirina 747, 800
Crypsirina vagabunda 438, 756
—— —— pallida ... 754, 801
—— —— vagabunda. 754, 801
—— —— vernayi ... 801
Cryptocoryne 308
Cryptomeria 21
Cryptoplectron manipurensis inglisi ... 567
Cryptoptilum 556
Cryptoxipha 552
Cryptoxipha ritsemae 554
Cuculus canorus 62
—— —— bakeri 210
—— —— canorus 895
—— —— *ssp.* 434
—— —— telephonus 434
—— micropterus 63
—— optatus 62
—— poliocephalus 63
—— varius varius 433
Cucumis melo 498
Cucurbita maxima 498
Culicicapa ceylonensis 43
—— —— calochrysea ... 747
—— —— ceylonensis ... 748
—— —— pallidior ... 747
Cuminum cyminum 499
Curetis thetis 372
Cursorius coromandelicus 424
—— cursor 766, 772
—— cursor cursor 423
Curimosphena fasciculatus 649
Cuscuta hyalina 502
Cutia nipalensis 32
Cyanops asiatica 62, 895
—— franklinii 62
Cyanosylvlia 768
Cyathula 534
—— capitata 533, 534, 535
—— ceylonica 533, 534, 535
—— prostrata 533, 534
—— tomentosa 533, 534, 535
Cyclops hyalinus 945
—— leuckarti 945
—— *sp.* 945
—— vermifer 945
Cycloptiloides 555
—— ceylonicus 555
—— orientalis 555
Cyclosa 874, 882

PAGE
Cyclotella 349, 625
Cygnus bewickii jankowskii 389
Cymbopogon 159, 174
—— caesius 176, 177
—— citratus 164
—— clandestinus ... 149, 152, 153
—— coloratus ... 152, 172, 173, 174, 178
—— distans ... 160, 161, 169
—— exsertus 165, 166
—— flexuoso 174
—— flexuosus ... 161, 162, 163, 164, 174, 175, 176, 177, 178
—— —— *forma* albescens ... 163, 176, 177
—— —— *var.* flexuosus. 162
—— —— *var.* microstachys. 162
—— —— *var.* sikkimensis... 162
—— gidarba 156, 157
—— —— *var.* burmanicus ... 157
—— hookeri 153
—— jwarancusa ...175, 178, 183
—— khasianus ... 168, 169
—— —— *var.* nagensis ... 169
—— martinii 152, 180
—— microtheca 157
—— —— *var.* sameshwarensis ... 159
—— nervatus 150, 153
—— parkeri 182
—— pendulus... ... 162, 163, 164
—— schoenanthus 180
—— stracheyi ... 159, 160
—— thwaitesii 171
—— tibeticus 154
—— travancorensis ... 163, 174, 175, 176, 178
—— virgatus ... 166, 167, 168
Cynictis pencillata 587
Cynodon dactylon ... 184, 185, 186, 322
Cyornis melanoleuca 892
—— poliogenys vernayi 747
—— rubeculoides 609
—— tricolor tricolor 892
Cyperus difformis 510
—— niveus 510

PAGE
Cyperus rotundus 510
Cypridopsis 349
Cyprinus carpio 350, 629
Cypselus *sp.* 895
Cypsiurus parvus (batasiensis) ... 442
Cyrtophora ... 874, 880, 881, 882
—— ciccatrosa 881
Cyrtoxiphus pusillus 554
Dactyloctenium aegyptium 511
Daemia extensa 501
Dahlia variabilis 108, 500
Dalbergia 73, 452
—— candenatensis 73
—— sissoo 496
Danais chrysippus 216, 368
—— —— *var.* dorippus ... 218
—— limniace mutina 368
—— plexippus 368
Danio aequipinnatus 631
Danaus aglea aglea 812
—— limniace 216
—— melanippus indicus 812
Dasyatis 833
Dasychira georgiana 215
Datura fastuosa 99, 504
—— metel 99, 100
—— —— *var.* fastuosa ... 99, 109
—— stramonium 99
Daucus carota 100, 499
Davidius zallorensis delineatus ... 567
Decaisnea 313
Delias 808
—— acalis pyramus 808
—— agostina agostina 809
—— eucharis 367
—— hyparete ethire 809, 810
—— sanaca sanaca *form* confusa ... 808
—— singhapura singhapura ... 808
Delichon nipalensis 56
—— urbica 614, 896
—— —— urbica 738
Delima sarmentosa 665
Delphacodes porpinqua 951
Delphinium 100
Delphinium ajacis 489
—— elatum 100
Demiegretta asha 383, 384
Dendrocalamus strictus ... 376, 432
Dendrocitta formosae 25
Dendrocygna bicolor 389

PAGE
Dendrocygna javanica 389
Dendronanthus indicus 610
Derectaotus 556
—— ceylonicus 556
—— palpatus 556
Derris 74
Derris canarensis 74
—— uliginosa 74, 80
Desmodium polycarpum 107
Deudorix epijarbas epijarbas ... 829
Deutzia stamina 665
Dianthus chinensis 491
Diapensia 310
Diaptomus 629
Dicaeum agile agile 786
—— concolor 787
—— erythrorhynchos 786
—— —— erythrorhynchos ... 787
—— ignipectus ignipectus ... 894
Dicentra thalictrifolis 665
Dicerorhinus sumatrensis ... 83, 84, 85, 87, 264, 266, 273, 275, 276.
Dichanthium 511
Dichanthium annulatum 511
—— caricosum 511
Dichromia orosia 649
Dicrurus 608
Dicrurus caerulescens 800
—— —— caerulescens ... 799
—— leucophaeus 49
—— —— longicaudatus ... 799
—— macrocercus ... 49, 208
—— —— peninsularis ... 798
—— paradiseus 756
—— —— malabaricus ... 800
Didymocarpus 309
Didymocarpus tomentosa 109
Digera 488
Digera arvensis 487, 506
Digitalis purpurea 100
Digitaria marginata 511
Dinopium benghalense benghalense... 450
—— —— dilutum ... 451
Diospyros 78, 312
Diospyros melanoxylon 376
—— peregrina 78
Dipterocarpus 312
Dipterocarpus tuberculatus (?) ... 307
Diplatys sinuatus 950

PAGE
Diplatys *sp.* ... 648
Discophora sondaica zal ... 817
———— timora timora ... 817
Dissemurus ... 747
Dissemurus paradiseus ... 438
Ditylum sol ... 116, 118, 122
Diurella ... 629
Dobinea ... 313
Dodona henrici deodata ... 820
——— ——— longicaudata ... 803, 819
Dodonea *sp.* ... 185
——— viscosa ... 494
Dolichandrone ... 80
———— spathacea ... 80
Dolichos biflorus ... 185, 323
——— lablab ... 185, 323, 495
Dorylus *sp.* ... 608, 609
Dracunculus medinensis ... 945
Dromas ardeola ... 422
Dryobates auriceps ... 895
——— cathpharius ... 59
——— darjelliensis ... 59
——— macei ... 59
Dryocopus javensis ... 377
——— ——— hodgsoni ... 451
Dryonastes caerulatus ... 28
——— ruficollis ... 27
Duabanga sonneratioides ... 307, 312, 459
Dumasia villosa ... 107
Dumetia hyperythra ... 762
——— ——— albogularis ... 752
——— ——— phillipsi ... 752
Duranta plumieri ... 505
Dysticus ... 437
Echinocarpus ... 312
Echinochloa crus-galli ... 511
Eclipta erecta ... 500
Ectatoderus ... 557
Ectatoderus ceylonicus ... 557
Egretta alba modesta ... 382, 383, 384
——— garzetta garzetta ... 383
——— intermedia ... 382, 383
——— ——— [intermedia]. 383, 384
Elaeocarpus ... 312, 316
Elanus caeruleus vociferus ... 391
Elatostemma sessile ... 110
Elephas maximus indicus ... 590
Elephus maximus ... 294, 851
Eleusine aegyptiaca ... 511
——— coracana ... 185, 322, 323
——— verticillata ... 511

PAGE
Elsholtzia strobilifera ... 110
Elymnias casiphone malelas ... 816
——— ——— saueri ... 816
——— peali ... 816
——— crenata ... 505
Emberiza buchanani ... 377, 777, 789, 790, 791
——— brunniceps ... 790
——— melanocephala ... 377, 790, 791
——— striolata striolata ... 790
Eneoptera ... 550, 553
Eneoptera alboatra ... 551
——— lateralis ... 551
Enicospilus *sp.* ... 649
Enicurus maculatus ... 37
Enkianthus ... 314, 315
Entada pursaetha ... 101
——— scandens ... 101
Epeira ... 883
Ephedra ... 10, 11, 12, 13, 488
Ephedra foliata ... 10, 11, 12
——— ——— *var.* ciliata ... 487, 512
——— peduncularis ... 10
——— vulgaris ... 11
Epimuta ... 825
Epimys (= Rattus) rufescens ... 860
Epipagis cancellalis ... 649
Epistylis ... 629
Equus hemionus ... 798
——— ——— khur ... 871
Eragrostis... 488
Eragrostis bifaria ... 185, 322
——— nutans ... 511
——— plumosa ... 511
——— stenophylla ... 511
——— viscosa ... 511
Eremopterix grisea ... 455
——— ——— siccata ... 455
Ergolis ariadne ... 370
——— merione taprobana ... 370
Erebia hyagriva ... 815
Eriboea athamas ... 369
Erinaceus ... 922
Eriobotrya ... 312, 314, 316
Eriophorum comosum ... 159
Erithacus rubecula ... 45
——— svecicus abbotti ... 767
——— ——— pallidogularis ... 767
——— ——— saturatior ... 767
Erythrina ... 448, 788
Erythrina erythrina erythrina ... 791

PAGE
Erythrina erythrina roseatus 791
———— indica 312
———— stricta 451, 756
Erythropygia galactotes 768
Ervatamia dichotoma 101
Esacus recurvirostris 423
Estrilda amandava amandava 794
———— formosa 794
Etroplus suratensis 350, 629
Euastrum 625, 629
Eublemma anachoresis 649
Eubranchella 473, 475
Eubranchella branchiata 473
Euchloe ausonia daphalis 810
Euchrysops cnejus 371
———— contracta contracta ... 823
———— pandava pandava ... 823
Eucosmetus *sp.* 648
Eucta 874, 876
Eucta javana 876
Eudynamis 575
Eudynamis scolopaceus scolopaceus ... 434
Eudynamys 575
Eugenia 308, 312, 347
Eugenia jambolana 497, 789
Euglena 624, 629
Euglena acus 625
———— oxyrius 625
———— spirogyra 625
———— viridis 625
Eulophia bicarinata 661
Eumyias thalassina 42
Eunetta falcata 607
Euonymus 308, 315, 316, 320
Eupagurus prideauxii 714
Euphorbia 450, 452, 488
Euphorbia clarkeana 509
———— geniculata 110
———— helioscopia 659
———— hirta 509
———— hypericifolia 665
———— microphylla 509
———— neriifolia 509
———— pilosa 665
———— prostrata 665
———— royleana 508
———— royleiana 11
———— splendens 509
———— thymifolia 509
Euploea core core 369
———— coreta coreta 396

PAGE
Euploea mulciber kalinga 812
Eurema blanda silhetana 811
———— hecabe simulata 368
———— libythea 367
———— simulatrix sarinoides ... 803, 811
Eurystomus orientalis 65
Euscelis indicus 648
Euscyrtus 561
Euscyrtus concinnus 561
———— hemelytrus 561
———— laminifer 562
———— necydaloides 562
———— perforatus 562
? Eustrongyloides *sp.* 945
Euthalia dunya 818
———— evelina derma 818
———— garuda garuda 818
———— kanda elicius 818
———— mahadeva binghami 818
———— merta eriphyle 818
———— nais 369
Euxoa sagetum 322, 324
———— spinifera 649
Everes parrhasius parrhasius 820
Evolvulus alsinoides 502
———— nummularis 665
Exacaecaria agallocha 361
Excoecaria 69, 81
Excoecaria agallocha 81
Exelastes atomosa 324
Fagonia cretica 493
Fagopyrum esculentum 110
Falco chicquera chicquera 403
———— jugger 402
———— peregrinus 403, 929
———— ———— babylonicus 403
———— severus 67
———— subbuteo 403, 929
———— tinnunculus 615
———— ———— objurgatus ... 404
———— ———— tinnunculus ... 404
Farsetia jacquemontii 487, 489, 495
Felis chaus 290
Feronia limonia 370
Ficus 312, 316, 400
Ficus bengalensis 375, 408, 428, 448, 509
———— benjamina 307
———— glomerata 408
———— pyriformis 308
———— religiosa 428, 448, 646, 787
Fimbristylis dichotoma 810

PAGE
Firmiana colorata 743, 756
Flacourtia *sp.* 185
Flemingia fruticulosa 107
——— lineata 665
Fluggea *sp.* 185
Foeniculum vulgare 499
Fragilaria 349, 625
Francolinus francolinus henrici ... 404
——— ——— *ssp.* ... 404
——— pictus 405
——— ——— pallidus 405
——— pondicerianus interpositus 405
Franklinia buchanani 753
Fregetta 335
Fregetta grallaria 334, 347
——— tropica 334, 347
Fringillauda brandtii 928
——— nemoricola nemoricola ... 894
Fritillaria 310
Fritillaria roylei 319
Fulica atra [atra] 411
Fumaria parviflora 489
Funambulus pennanti 799
Gadusia chapra 624, 625
Galathea strigosa 714
Galeocerdo tigrinus 835
Galerida 454
Galerida cristata 458
——— ——— chendoola 457
——— deva 454, 458
——— malabarica 457. 458
Galleria mellonella 948, 950
Gallicrex cinerea 411
Gallinula chloropus [indica] 411
Galloperdix spadicea 867
——— ——— caurina 407
——— ——— spadicea ... 407
Gallus gallus 298
——— sonnerati 408, 603
Gamblea 314, 315
Gambusia affinis 350, 631
Gandaca harina assamica 810
Gangara thyrsis thyrsis 373
Gardenia tubifera 14
Garrulax albogularis 28
——— ——— albogularis ... 888
——— moniliger 28
——— pectoralis 28
Gasteracantha 874, 884
Gasteracantha arcuata 884
——— brevispina 884

PAGE
Gasteracantha remifera 884
Gaultheria *sp.* 315
Gavialis gangeticus 865
Gazella bennetti 867, 870
Gecinulus grantia 59
Gelasimus annulipes 703
——— cultrimanus 705
——— marionis 705
——— ——— *var.* nitidus ... 705
——— nitidus 705
——— vocans 705
Gelochelidon nilotica nilotica ... 426
Gennaeus lathami 269
——— melanotus 68
Genosia obeditalis 951
Gentiana 310
Geokichla citrina 618
——— ——— citrina 610
Geranium wallichii 665
Gerydus boisduvali assamensis ... 820
Ginkgo biloba 101
Girardinia zeylanica 664
Gisekia pharnaceoides 487, 499
Glaucidium 800
Glaucidium brodiei 66
——— cuculoides 66
——— radiatum radiatum ... 438
Glossocardia boswallia 500
——— linearifolia 500
Glyphodes bivitralis 649
Gmelina arborea 312
Gnaphalium luteo-album *var.* multiceps 500
Gnathostoma spinigerum 945
Gomphonema 349
Gomphrena celosiodes 508
——— globosa 507
Gonatozygon 629
Gongylus gongyloides 644
Goniopteris 308
Gonium 349
Gordonia axillaris 313
Gossypium 375
Gossypium hirsuta *var.* brasiliense ... 221
Grammatophora 116
Grammatoptila striata 29
——— ——— ——— striata ... 889
Grangea 77
Grangea maderaspatana 77
Graphium agamemnon menides ... 367
——— euryplus *f.* jason ... 367
——— eurypylus jason 366

PAGE
Graphium nomius 366
———— ———— nomius 367
———— teredon sarpedon 367
Grewia betulaefolia 492
——— populifolia ... 492, 743, 785
——— tiliaefolia 376
Grus antigone antigone 410
—— grus lilfordi 409
—— nigricollis 605, 930
Gryllodes 545, 546
Gryllodes berthellus 547
——— greeni 546
——— sigillatus 545
——— supplicans 546
Gryllopsis 546
Gryllopsis falconneti 546
Gryllotalpa africana 542
——— orientalis 542
——— ornata 542
Gryllus 542, 543, 544, 545, 547, 549, 561
Gryllus berthellus 547
——— bimaculatus 544
——— bucharicus 545
——— confirmatus 545
——— consobrinus 545
——— flavipes 545
——— flavus 544
——— occipitalis 541
——— parviceps 543
——— punctulipes 545
——— quadristrigatus 544
——— supplicans 546
Gryllulus blennus 545
——— brevicauda 545
——— configuratus 544
——— mitratus 544
——— pallipes 545
——— testaceus 544
gurial, (Ramphalcyon capensis) ... 575
Gymnanthelia nervata 150
Gymnodinium 625
Gymnogryllus erythrocephalus ... 543
———— humeralis 543
Gymnorhis 394
Gymnorhis xanthocollis 746
Gymnosporia 185, 375, 488
Gymnosporia montana ... 11, 375, 494
Gynandropsis gynandra ... 101, 490
———— pentaphylla ... 101, 490
———— speciosa 665
Gynocardia odorata 102

PAGE
Gynura pseudochina 665
Gypaëtus barbatus ... 67, 614, 929, 923
Gyps fulvus *ssp.* 399
—— himalayensis 67, 400, 614
—— indicus *ssp.* 400
Gyrosigma 116, 117, 349
Haemadipsa 468, 469
? Haemadipsa dussumieri 468
Haemadipsa montana 468, 469
———— ornata ... 468, 469, 471
———— picta ... 468, 469, 471
———— zeylanica 468, 469
Haematopus ostralegus [ostralegus]... 413
Haematornis cheela 67
Haematospiza sipahi 55
Halcyon pileata 445
——— smyrnensis ... 65, 398, 445, 608
Haliaëtus leucogaster 339
——— leucoryphus ... 399, 929
Haliastur indus 67, 396
Haliastur indus indus 393
Hamiltonia suaveolens 107
Haraldus chelaka lenya 821
Harpactes erythrocephalus 65
——— fasciatus 377
——— malabaricus legerli ... 443
——— ——— malabaricus ... 443
Hasora alexis alexis 372
Hedera helix 102
Hedotettix costatus 950
Hedychium 313
Heleochloa schoenoides 659
Helianthus annus 500
Helica 313, 316
Helica excelsa 313
Heliocopris bucephalis 649
Heliophorus androcles moorei ... 824
———— brahma mogoka... ... 824
Heliothis obsoleta 324
Heliotropium eichwaldi 502
———— marifolium *var.* wallichii 665
———— strigosum 502
———— zeylanicum 502
Hemerocallis 309
Hemiaulus 116
Hemichelidon ferruginea 41
———— sibirica 41
———— ——— cacabata ... 891
Hemicircus 451

PAGE
Hemicircus canente 377, 453
——— ——— cordatus 453
Hemiechinus auritus collaris ... 584, 921, 922
——— collaris 921
Hemigaleus balfouri 832, 839
Hemigraphis hirta 664
Hemilandreva 549
——— lamellipennis 549
Hemipristis elongatus 832, 839
Hemiprocne longipennis coronata ... 442
Hemipus 575
——— picatus 46, 377, 741
——— ——— picatus 738
Hemitragus 246
Heptagenia *sp.* 859
Herennia 874, 883
——— ornatissima 883
Heritiera baen 361
Herodias alba 936
Herpestes 187, 188
Herpestes smithi zeylanicus ... 587, 860
——— vitticollis 587
Heterogamus *sp.* 649
——— ——— *nr.* percurrens ... 951
Heteropogon contortus 511
Heterotrypus elegans 560
——— vicinus 559
Heteroxenicus cruralis 36
Hibiscus 72
——— esculentus 492
——— gibsoni 492
——— hirtus 664
——— rosa-sinensis 492
——— tiliaceus 72
——— vitifolius 664
Hieraëtus fasciatus fasciatus 395
——— ——— grandis 396
——— pennatus ... 392, 396, 397
——— ——— milvoides 396
——— ——— pennatus 396
Hierococcyx sparverioides 63
——— varius 64
Himantopus himantopus himantopus 422
Hippa 947
Hipparchia actaea magna 814
——— boloricus 815
——— ——— chitralica ... 815
——— moorei 815
——— ——— gilgitica 815
——— ——— moorei 815

PAGE
Hipparchia persephone enervata ... 814
——— regeli 815
Hippolais caligata caligata 756
——— ——— rama 756
Hirudo 473, 474
——— branchiata 473, 475
Hirundapus caudacutus 66
Hirundinaria manillensis 470
Hirundo concolor 736
——— ——— concolor 736
——— daurica 56, 442
——— ——— erythropygia ... 737
——— ——— hyperythra 607
——— ——— nipalensis 737
——— fluvicola 737
——— rupestris 736
——— rustica 56, 737
——— ——— ambigua 736
——— ——— gutturalis ... 345, 736
——— ——— rustica 736
——— smithii filifera 737
Hodgsonius phoenicuroides phoenicuroides 890
Holcus sorghum 184, 324
——— spicatus 184, 324
Homaloblemmus 547
Homaloblemmus cavifrons 547
Homalocenchrus hexandrus 659
Homalogryllus 557
——— depressus 557
Homo 598
Homochlamys fortipes 53
Homoeoxipha 554
——— histrio 554
——— lycoides 554
Homoeoxiphus 552
Homonoia riparia 308
Hoplopterus indicus indicus 414
——— malabarica 414
Horaga amethystus 828
——— ——— purpurascens. 803, 828
——— moulmeina 828
——— onyx 828
Hordeum 511
Horeites brunnifrons 53
Horsfieldia anita dina 372
Hura crepitans 102
Hyboella latifrons 950
Hydnocarpus kurzii 102
——— laurifolia 103
——— wightiana 103

PAGE
Hydrilla verticillata ... 349, 509
Hydrillodes morosa ... 649
Hydrophasianus chirurgus ... 413, 606
Hydroprogne tschegrava tschegrava ... 425
Hylobates hoolock ... 269
Hymenia recurvalis ... 649
Hyoscyamus muticus ... 103, 665
———— niger ... 103
Hypacanthis spinoides ... 55
———— ———— spinoides ... 893
Hypena strigata ... 649
Hypolimnas missipus ... 370
Hypoprion macloti ... 832
Hypothymis ... 747, 800
Hypothymis azurea ... 756
———— ———— styani ... 749
Hystrix leucura ... 292
Ianthia cyanura rufilata ... 891
Ianthocincla ocellata ocellata ... 888
Ibidorhyncha struthersii ... 896
Ibis leucocephalus ... 399
—— ———— leucocephalus ... 385
Ichthyobdella ... 474
Ichthyophaga ichthyaetus [ichthyaetus] 399
Ichthyophis glutinosus ... 639
———— monochrous ... 640
Ictinaëtus malayensis [perniger] ... 399
Ilex ... 313, 314, 316
Ilex crenata ... 314
—— ———— nothofagifolia ... 314
—— sikkimense ... 314
Illicium *sp.* ... 314
Ilysanthes ... 79
Ilysanthes tenuifolia ... 79
Impatiens ... 309
Indigofera argentea ... 495
———— articulata ... 495
———— cordifolia ... 495
Ipomea pilosa ... 664
———— wightii ... 665
———— batatas ... 503, 661
———— biloba ... 503
———— blancoi ... 661
———— hederacea ... 104, 503
———— leari ... 503
———— pes-tigridis ... 503, 664
———— pileata ... 661
———— pulchella ... 503
———— triloba ... 661
Iraota timoleon timoleon ... 825

PAGE
Iris *sp.* ... 309
—— wattii ... 309
Itaropsis parviceps ... 543
———— tenellus ... 543
Ixias marianne ... 368
—— pyrene frequens ... 368
Ixobrychus cinnamomeus ... 687, 689
———— sinensis ... 687
———— ———— [sinensis] ... 384
Ixodes ... 861, 863, 864
Ixodes acutitarsus ... 860, 861
—— ceylonensis ... 860, 861
—— gigas ... 861
—— granulatus ... 860, 861, 864
—— holocyclus ... 860, 861
—— japonensis ... 860, 861
—— kempi ... 864
—— kerri ... 861, 862, 863
—— radfordi ... 860, 861
—— ricinus ... 860, 861
Ixora parviflora *var.* zeylanica ... 665
Ixulus flavicollis ... 31
—— ———— flavicollis ... 889
Iynx torquilla chinensis ... 449
—— ———— *ssp.* ... 449
Jacaranda mimosifolia ... 646, 647
Jamides celeno celeno ... 371
Jasminum ... 312
Jasminum humile ... 501
Jatropha curcas ... 104
———— glandulifera ... 104
———— gossypifolia ... 104
———— multifida ... 105
Juniper ... 311
Juniperus ... 245
Justicia ... 488
Justicia adhatoda ... 505
———— diffusa ... 505
———— quinqueangularis ... 505
———— royeniana ... 659
———— simplex ... 505
Kachuga dongboka ... 474, 476
———— intermedia ... 476
———— smithi ... 476
———— tectum ... 474, 477
Kallima inachus huegelii ... 819
Kandelia ... 75
Kandelia rheedi ... 75
Katelysia apima ... 125, 129
Kirchneriella ... 625
Kleinhovia hospita ... 829

PAGE
Kochia indica 508
Labeo 629
Labeo fimbriatus 350, 629, 634
——— rohita 350, 635
Laccifer (= Lakshadia) communis ... 646
——— (= Tachardia) lacca 645
Lacerta *sp.* 615
Laelia litura 649
Lagascea mollis 659
Lagenaria siceraria 105
——— vulgaris 105, 498
Lagerstroemia flos-reginae 105
——— speciosa 105
Laiscopus collaris 928
Lalage melaschista 48
——— sykesi 575
Lammna 332
Lampides boeticus 371, 807
Landreva 549
Landreva angustiformis 549
——— clara 549
——— insignis 549
——— subaptera 549
Lanius 608
Lanius caniceps caniceps 782
——— collurio 781, 783
——— ——— bogdanowi 782
——— cristatus 618
——— ——— cristatus 783
——— erythronotus erythronotus ... 782
——— excubitor lahtora ... 779, 780, 782
——— isabellinus 768, 780, 782
——— lahtora 782
——— nigriceps 32, 45
——— ——— nigriceps 892
——— phoenicuroides 768, 780, 781, 782, 783
——— ——— isabellinus ... 782
——— schach 46, 6.8, 782
Lanius schach caniceps ... 781, 782
——— ——— erythronotus ... 781, 782
——— ——— kathiawarensis 782
——— ——— nepalensis 892
——— vittatus 780, 781, 782, 783
Lantana camara *var.* aculeata ... 185
——— crenulata 665
——— indica 505
Laphygma exigua 322, 324
Laponicum 310
Larix 311
Larvivora brunnea 36, 890
Larus argentatus cachinnans 425
Larus brunnicephalus ... 424, 425, 930
——— fuscus 930
——— ——— taimyrensis 425
——— ridibundus 424, 425
Lasioderma sericorne 649
Lathyrus aphaca 496, 515, 664
——— sativus 515
——— sphericus 664
Launaea nudicaulis 500
Lawsonia alba 497
Leea 73
Leea sambucina 73
Leioptila capistrata 30
——— ——— capistrata ... 889
Leiothrix lutea 31
Leonotis nepetaefolia 506
Lepidagathis trinervis 505
Lepidium sativum 490
Lepidogathis *sp.* 185
Lepocinclis 625
Leptadenia 765
Leptadenia spartium 412, 487, 502, 758, 775
Leptocoma jugularis 16
——— ——— microleuca ... 16
Leptoptilos dubius 386
——— javanicus 386
Leptosia nina nina 367
Lepus ruficaudatus 292
Lethe 813
Lethe dura gammiei 813
——— margaritae 813
——— rohria nilgiriensis 369
——— rorhia neilgheriensis 813
——— sinorix 813
——— yama yama 813
Leucas aspera 506
Leucauge 874
Leucauge (Argyroepeira) 877
Leucauge bengalensis 877
——— celebesiana 877
——— culta 877
——— decorata 877
——— fastigata 877
——— tessellata 877
——— ventralis 877
Leucocerca albicollis 45
Libythea myrhha myrhha 369
Licocoris *sp.* 648
Ligustrum 308
Limenitis procris procris 369
Limicola falcinellus 421
Liminitis procris procris 818

PAGE
Limninitis procris undifragus 818
Limnanthemum 79
Limnanthemum parvifolium 79
Limnophila 79
Limnophila gratissima 79
Limosa limosa limosa 417
——— lapponica lapponica 417
Lindenbergia macrostachya 665
——————— urticaefolia 664
Linum usitatissimum 493, 515
Liogryllus 544
Liorhyssus rubicundus 648
Liphoplus 556
Liphoplus ceylonicus 556
Litsaea polyantha 459
Lloydia 310
Lobelia nicotianaefolia 516
Locustella naevia straminea 761
Lolium perenne 659
——— temulentum 659
Lonchura malabarica 794
——— punctulata lineoventer ... 795
——— striata striata 794
Lonicera 310, 312, 315, 881
Lophobdella 474
Lophophorus impejanus ... 615, 895
Loranthus 787, 788, 789
Loranthus ampullaceous 665
——— *spp.* 743, 744
Loxoblemmus 548
Loxoblemmus equestris 548
——— longipalpis 548
Loxura atymnus atymnus 372
Luffa acutangula 498, 516
——— cylindrica 516
Lumnitzera 69, 76
Lumnitzera racemosa 76
Luzara 559
Luzaropsis 559
Luzaropsis ferruginea 559
——— henryi 559
Luzula 315
Lycaena kasyapa *var.* zariaspa ... 824
Lycaenesthes dubiosa indica 824
——— ——— sivoka 824
——— emolus emolus 823
——— lycaenina lycaenina 371, 824
Lycaenopsis 821
Lycaenopsis argiolus jynteana 803, 822
——— ——— sikkima ... 803, 822
——— ceyx cerima ... 803, 821

PAGE
Lycaenopsis ceyx ceyx 821
——— ——— tanarata 821
——— lavendularis limbatus ... 821
——— lilacea 822
——— musina musinoides ... 822
——— puspa 822
——— ——— gisca ... 371, 822
Lycium 11
Lycium europaeum 11
Lycopersicum esculentum 504
Mabuya *sp.* 940
Macaca nemestrina 269
Macropygia unchall 68
Madasumma 560
Madasumma albonotata 560
——— greeni 560
——— incerta 561
——— marginipennis 560
——— praecipua 560
——— valida 561
——— varipennis 561
Madhuca indica 517
——— longifolia 517
Maerua arenaria 490
Magnolia 312, 314, 316
Magnolia campbellii (mollicomata) ... 314
——— rostrata 314
Malachra capitata 664
Malus sylvestris 517
Malva verticillata 106, 491
Malvastrum spicatum 664
Mangifera indica 355, 375
Manglietia 312
——— caveana 307
Maniola 814
Maniola davendra chitralica 814
——— hilaris 807, 814
——— tenuistigma 814
——— ——— laspura 814
Marsilea 954, 956
——— aegyptiaca 954, 955
——— brachycarpa 955
——— brachypus 955
——— condensata 955, 956
——— coromandelica 955
——— gracilenta 955
——— minuta 955, 956
——— poonensis 955
——— quadrifolia 955, 950
Martynia diandra 504
Mastogloia 629

PAGE
Meconopsis 310
Megalaima haemacephala confusa ... 449
—— —— indica ... 449
—— virens 61
—— viridis 449
—— zeylanicus 575
Megalestes irma 566
Megisba malaya sikkima 820
—— —— thwaitesi 820
Melanitis leda ismene 369, 816
Melanochlora sultanea 26
Melanocorypha maxima 929
Melanorrhoea glabra 459
Melia azadirachta 93, 375, 494
—— azedarach 494, 517
Melilotus alba 495
—— indica 495
—— officinalis 518
—— parviflora 495
Melochia 72
Melochia corchorifolia 72
Melophus lathami 598
—— melanicterus 894
Melosira ? 116, 117, 629
Melursus ursinus 869
Mentha 506
Mergus albellus 391
Meriones hurrianae 504
Merismopedia 349, 625
Merops 608
Merops orientalis 208
—— —— biludschicus ... 446
—— —— orientalis 446
—— superciliosus persicus ... 445
Merremia hastata 503
Mesia argentauris 34
Mesocyclops 349, 629, 632
Mesua ferrea 312
Metasequoia 311, 312
Metioche 5
Metiochodes 552
Metiochodes greeni 552
—— trilineatus 553
Metochus uniguttatus 648
Metopidius indicus 413, 423
Michelia 307, 312, 314, 316
Michelia bailloni 307
Microbracon hebetor 649
Microcichla scouleri 37
—— —— scouleri 890

PAGE
Microcystis 349, 629
Microcystis aeruginosa 629
Microhyla ornata 637, 638
Micropternus brachyurus jerdoni ... 450
Micropus affinis 66, 208
Microscelis flavala 34
—— macclellandi 34
—— psaroides 34, 889
Milvus migrans 297
—— —— govinda 67
—— —— lineatus 67
—— milvus 392
—— —— govinda 393
Mimosa 11,74
Mimosa hamata 497
—— pudica 71, 96
—— rubicaulis 11
Mimusops elengi 501
Minla ignotincta 32
Mirabilis jalapa 506
Mirafra erythroptera 601
—— —— —— erythroptera ... 455
—— —— sindiana ... 445
—— javanica cantillans ... 454, 458
Mixornis gularis 29
Mnesibulus 561
Mnesibulus pallipes 561
Mobula 833
Mocis frugalis 649
Moghania macrophylla *var.* viridis ... 665
Moina 349
Mola mola 323
Mollugo 488
Mollugo cerviana 487, 499, 664
—— hirta 499
—— nudicaulis 499
Molpastes cafer 35
—— leucogenys 35
—— —— leucogenys ... 889
Momordica charantia 498
Monotheca 245
Monsonia senegalensis 493
Monticola cinclorhyncha ... 40, 771, 891
—— rufiventris 40
—— solitaria 41
—— solitarius longirostris ... 771
—— —— pandoo 771
—— —— transcaspica ... 771
Montifringilla nivalis 928
—— ruficollis 928
—— *sp.* 614

PAGE
Montifringilla taczanowski 614
Moringa 483
Moringa pterigosperma 494
Morus alba 509
—— laevigata 312
Moschiola memina 294
Motacilla alba 614
—— —— alboides 614
—— —— baicalensis 894
—— —— dukhunensis ... 614, 779
—— —— leucopsis 614
—— —— personata 614
—— cinerea 56, 614, 619
—— —— caspica ... 894, 929
—— —— melanope 779
—— citreola 929
—— —— citreola 778
—— —— werae 778
—— flava beema 778
—— —— melanogriseus ... 778
—— —— thunbergi 778
—— indica 779
—— maderaspatensis ... 602, 779
Mougeotia 349
Mundulea sericea 518
—— suberosa 518
Muntiacus muntjac 870
—— muntjak aureus 860
—— —— vaginalis 860
Murdannia 137, 138, 658
Murdannia dimorphum 658
—— elatum 658
—— giganteum 658
—— lanuginosum 658
—— malabaricum 658
—— nudiflorum 658
—— ochraceum 658
—— pauciflorum 658
—— scapiflorum ... 138, 658
—— semiteres 658
—— sinicum 658
—— spiratum 658
—— vaginatum 658
—— versicolor 658
Murraya exotica 493
—— koenigii 493
Musca vomitoria 382
Muscicapa latirostris 746
—— parva parva 746
—— striata neumanni 377
—— thalassina thalassina ... 747

PAGE
Muscicapa tickelliae 756
—— —— tickelliae ... 747
Muscicapula hodgsoni 43
—— hyperythra 43
—— magnirostris 43
—— melanoleuca 42
—— rubeculoides 43
—— sapphira 43
—— superciliaris 43
—— tickelliae 43
Muscisylvia leucura 38
Mussaenda 308
Mustelus antarcticus 834
—— laevis 843
—— vulgaris 834
Mycalesis igilia igilia 812
—— malsara 813
—— perseus 369
—— suavolens suavolens... 812, 813
—— —— tytleri ... 812, 813
—— visala visala 812
Myiophoneus coeruleus 41
—— caeruleus temminckii ... 891
—— horsfieldi ... 377, 775
Myliobatis 833
Myllocerus cardoni 951
Myrica nagi 307
Myristica fragrans 518
—— malabarica 519
Myrmarachne 251, 254, 255
Myrmarachne manducator 260
—— plataleoides ...249, 250, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263,
—— ramunni 260
—— spissus 260
Myrmecophila 555
Myrmecophila dubia 555
—— escherichi 555
Myrmecophilus 555
Myrmegryllus 555
Myromophilellus 555
—— pilipes 555
Nabis capsiformis 648
Nacaduba noreia noreia 824
Navicula 7, 116, 349, 625
Nectarinia 247
Nectarinia asiatica asiatica ... 787, 788
—— —— brevirostris ... 787
—— lotenia 788
—— zeylonica 787

PAGE

Nemachilus rupicola *var.* inglisi ... 567
Nemobiodes ... 546
Nemobiodes ceylonicus ... 546
—— laeviceps ... 546
—— nigrocephalus ... 546
Nemobius ... 551
Nemobius ceylonicus ... 550
—— histrio ... 551
—— infernalis ... 551
—— javanus ... 551
—— nigrosignatus ... 551
Neodiaptomus ... 349
Neotermes assmuthi ... 648
Neophron percnopterus *ssp.* ... 400
Nephila ... 874, 878, 879
Nephila maculata ... 874, 879
—— malabarensis ... 879
Nephopteryx *sp.* ... 649
Nephotettix apicalis ... 648
—— bipunctatus ... 648
Neptis columella ... 369
—— —— nilgirica ... 818
—— hylas varmona ... 370
—— yerburii sikkima ... 818
Neptunia oleracea ... 659
Neptunus pelagicus ... 946
—— sanguinolentus ... 946
Nerium odorum ... 501, 954
Netelia *sp.* ... 649
Netrium ... 349
Netta rufina ... 391
Nettapus coromandelianus ... 391
Nicoria trijuga ... 474
Nicotiana plumbaginifolia ... 664
Nigella sativa ... 519
Niltava grandis ... 44
—— macgrigoriae ... 45
—— sundara ... 44
Ninox scutulata *ssp.*? ... 438
Nitzschia ... 349, 629
Nitzschia closterium ... 116, 117, 118, 119, 122, 123
—— longissima ... 116, 119, 123
—— pugens ... 118, 119
—— —— *var.* atlantica ... 116
Nodaria cornicalis ... 649
Nomocharis ... 310, 315, 316
Notholirion ... 310
Notocrypta paralysos alysia ... 373
Nucifraga caryocatactes hemispila ... 887

PAGE

Numenius arquata orientalis ... 416
—— phaeopus ... 707
Nyctanthes arbor-tristis ... 501
Nyctibatrachus ... 855, 856, 857,
Nyctibatrachus humayuni 853, 855, 857, 939
—— major ... 852, 855
—— pygmaeus ... 855, 856
—— sanctipalustris ... 855, 857
Nycticorax nycticorax nycticorax ... 384
Nyctiornis athertoni athertoni ... 446
Nymphaea ... 71
Nymphaea stellata ... 71
Nymphula diminutalis ... 649
—— stagnalis ... 649
Oceanites oceanicus ... 334, 338, 343, 347
—— —— exasperatus ... 348
—— —— magellanicus ... 347
—— —— oceanicus ... 348
—— —— parvus ... 347, 348
Ocimum ... 487
Ocimum sanctum ... 506
Ocypode arenaria ... 715
Odontotermes ... 465, 466
Odontotermes obesus ... 459, 951
—— parvidens ... 459, 460, 461
—— redemanni ... 463, 465, 466
Oecanthus ... 557, 562, 939
Oecanthus henryi ... 558
—— indicus ... 557
—— rufescens ... 558
Oecophylla ... 251, 252, 253, 254, 255, 256, 262
Oecophylla smaragdina... ... 249, 262
Oedogonium ... 269
Oenanthe capistrata ... 773
—— deserti ... 772, 927
—— —— atrogularis ... 772
—— isabellina ... 776, 771
—— opistholeuca ... 772, 773
—— picata ... 772, 773
—— xanthoprymna chrysopygia 772
Ohiopogon ... 309
Oldenlandia ... 77
—— pruinosa ... 77
Oligotoma saundersi ... 951
Omphallogramma ... 310
Ophiocytium ... 625
Opuntia dillenii ... 498
Ordgarius ... 874, 884

PAGE

Ordgarius hobsoni 884
——— sexspinosus 884
Oreicola ferrea ferrea 870
Oreocincla mollissima 40
Oreocorys sylvanus 57, 894
Oreosolen 310
Oriolus oriolus kundoo 797
——— traillii 54
——— xanthornus 54
——— ——— maderaspatanus. 797
——— ——— xanthornus ... 798
Ornebius 556
Ornebius guerini 556
——— varipennis 556
Orobanche cernua 664
Orsinome 874, 876
Orsinome marmorea 876
Orthomiella pontis pontis 824
Orthotomus 761
Orthotomus sutorius 52
——— ——— guzurata ... 763
——— ——— maculicollis ... 14
Oryctes rhinoceros 649
Oryzias melastigma 350, 631
Oscillatoria 7, 349, 625, 629
Oscillatoria tenuis 629
Osphronemus goramy 350
——— gourami 146
Otocoris alpestris elwesi 929
Otus bakkamoena *ssp.* ... 66, 436
Ougeinia dalbergiodes 376
Ovis ammon poli 923
Oxalis corniculata 493
——— latifolia 659
Ozarba hemiphaea 649
——— *sp.* 649
——— *nr.* lepida 951
Ozobranchus 473, 474, 475, 479
Ozobranchus branchiata 475
——— branchiatus ... 473, 474, 475, 477, 478, 479
——— jantseanus ... 474, 476, 477, 478, 479
——— margoi ... 474, 476, 477, 478, 479
——— menziesi 473
——— papillatus ... 473, 474, 776, 477, 478, 479
——— polybranchus ... 474, 477, 478, 479
Ozobranchus shipleyi ... 474, 476, 477, 478, 479
Paeonia emodi 520
——— officinalis 520
Palamnaeus bengalensis ... 536, 537, 538
Pandion haliaëtus haliaëtus 402
Pandorina 349, 629
Panicum 82
Panicum crus-galli 511
——— repens 82
——— trypheron 222
Panolia eldi thamin ... 264, 278, 302
Panthera leo persica 867
——— pardus 288, 870
——— tigris 286, 870
Papaver rhoeas 489, 520
Papilio 3 5
Papilio arcturus arcturus 804
——— aristolochiae 365
——— crino 366, 805
——— demoleus 366
——— ——— demoleus 366
——— dravidarum 805
——— hector 365, 366
——— krishna krishna ... 804, 805
——— memnon agenor 804
——— polyctor stockleyi ... 803, 804
——— polymnestor 366
——— polytes 365
——— ——— cyrus 805
——— ——— polytes 366
——— ——— romulus 805
——— ——— *form* stichius ... 365, 366
Paraechinus micropus micropus 584, 921
Paragrewia poilanei 190
Paranaxipha 553
——— ornatipes 553
Paratelphusa guerini 941
Parnassia... 310
Parnassius 806
——— charltonius ? deckerti ... 806
——— ——— ducalis. 807, 808
——— delphius 807
——— ——— chitralica ... 807
——— ——— hunza 807
——— epaphus 806
——— ——— ?hinducucica. 806, 807
——— hardwickei hardwickei ... 806
——— jacquemontii chitralensis. 807
——— ——— jacquemontii. 806
——— simo 806

PAGE
Parnassius stoliczkanus nicevillei ... 806
—— —— saserensis ... 806
—— thianschanica 807
—— tianschanica binghami ... 806
Paranemobius pictus 550
Parkinsonia aculeata 496
Parsonia spiralis 79
Parus ater aemodius 888
—— dichrous dichrous 888
—— major 25
—— —— stupae 785, 786
—— monticolus 26
—— —— monticolus 888
—— nuchalis 784, 786
—— rubidiventris 888
—— xanthogenys aplonotus ... 786
Pasania 312
Paspalum sanguinale 511
—— scrobiculatum 207
—— vaginatum 659
Passer domesticus 56, 403, 601
—— —— biblicus 601
—— —— indicus 792
—— montanus 56
—— —— malaccensis 894
Pastor roseus 377
Patiscus 562
Patiscus quadripunctatus 562
Pavetta 77
Pavetta indica 77
Pavo cristatus 297, 408
Pecten *sp.* 125
Pedicularis 315
Pediastrum 349, 625, 629
Peganum harmala 493, 520
Pelargopsis capensis gurial 444
Pelecanus onocrotalus 380
—— philippensis crispus ... 380
—— —— philippenis 380, 381
Pellorneum ruficeps 29
—— —— mandelli 889
—— —— ruficeps 750
Pelochelys bibroni 474, 477
Peltophorum ferrugineum 646
Pennisetum 512
Pennisetum cenchroides 511
—— ciliar 659
—— typhoideum 375
Pentacentrus 557
Pentacentrus pulchellus 557
Pentaneura *sp.* 650

PAGE
Pentapterygium 313
Perdicula 398
Perdicula argoondah 406
—— asiatica asiatica 406
—— —— meinertzhageni ... 407
Pericrocotus brevirostris 47
—— —— —— brevirostris 892
—— cinnamomeus cinnamomeus 741
—— —— pallidus ... 741
—— erythropygius 785
—— —— erythropygius ... 741
—— flammeus ... 47, 377
—— —— flammeus ... 740
—— —— semiruber ... 741
—— —— speciosus ... 741
—— peregrinus dharmakumari 741
Peridinum... ... ... 349, 625
Perigea serva 649
Perigrinus maidis 951
Periopthalmus 384
Perkinsiella fascialis 648
—— insignis 648
Pernis orientalis 392
—— ptilorhynchus ruficollis 392, 393
Perotis indica 511
—— latifolia 511
Petaurista petaurista philippensis 861, 863
Petinia nyctaginiflora 504
Petronia xanthocollis transfuga ... 792
—— —— xanthocollis ... 792
Phacus 349, 625, 629
Phaeneilema 137
Phaethon indicus ... 335, 336, 337, 339
—— *sp.* 335
Phalacrocorax carbo [sinensis] ... 381
—— fuscicollis 381
—— niger 381
Phalaris minor 659
Phalaropus 336, 347
Phalaropus fulicarius 337
—— lobatus 337
Phaseolus mungo 185, 323
—— radiatus 323
Philautus 939
Philautus bombayensis ... 852, 939
—— (Ixalus) variabilis 856
Philodina 629
Philomachus pugnax 421
Philyra scabriuscula 640, 641

PAGE
Phlogacanthus 308
Phoeniconaias minor 5, 7, 388
Phoenicurus frontalis 38, 613, 891
——— grandis 927
——— ochrurus 38
——— ——— ochruros phoenicuroides 768, 769
——— ——— rufiventris 768, 891, 927
Phoenicopterus ruber 376, 388
——— ——— antiquorum ... 871
——— ——— roseus 5, 387
——— ——— ruber 6
Phragamaticola 575
Phragmaticola 575
Phycita *sp.* 951
Phyllanthus 308
Phyllanthus maderaspatensis 509
——— niruri 509
——— reticulatus 759
Phyllognathus dionysius 649
Phylloscopus 554, 756, 892
Phylloscopus affinis 928
——— collybita tristis 759
——— griseolus 759
——— inornatus humei 759, 761
——— maculipennis 892
——— occipitalis occipitalis ... 760
——— pulcher pulcher ... 892
——— reguloides 892
——— trochiloides nitidis ... 760
——— ——— viridanus ... 760
——— trochilus acredula ... 760
——— tytleri 761
Physalis minima 503
——— peruviana 503
Physis carbonariella 262
Phytobdella 469
Phytobdella cantenifera 469
Picea 311
Picoïdes auriceps 246
——— dorae 246
——— mahrattensis 246
——— ——— aurocristatus ... 452
——— ——— mahrattensis ... 452
——— nanus 783
——— ——— hardwickii 452
Picus canus gyldenstolpei 58
——— chloropus 59
——— chlorolophus chlorigaster ... 450
——— squamatus squamatus 895

PAGE
Pieris 312, 313
Pieris dubernardi chumbiensis ... 809
——— krueperi devta 809
——— napi melaena 810
Piestoxiphus 552
Pilea microphylla 664
——— peploides 665
Pinctada martensii 125, 130
——— pinctada ... 124, 129, 130, 135
——— vulgaris 125
Pinnularia 349
Pinus insularis 169
——— longifolia 459
——— wallichianum 886
Piprisoma agile agile 895
Piscicola 474
Pisum sativum 496
Pithecellobium bigeminum 520
Pithecolobium saman 392
Pitta brachyura [brachyura] 454
Pittosporum eriocarpum 665
Planktonema 349
Platalea leucorodia [major] 387
Platydactylus 561
Plectranthus rugosus 110
Plegadis falcinellus [falcinellus] ... 387
Plesmonium margaritiferum 521
Pleurococcus 625
Pleurogyne 310, 349
Pleurosigma 625
Ploceus benghalensis 793
——— megarhynchus 599, 600
——— ——— rutledgii ... 600
——— philippinus philippinus ... 793
——— ——— sardarpateli ... 793
Pluchea lanceolata 500
Pluvialis dominica fulva 415
——— squatarola 414
Pnoepyga albiventer albiventer ... 890
Poa 222
Podiceps caspicus caspicus 380
——— cristatus cristatus 380
——— nigricollis 380
——— ruficollis capensis 380
Podoces humilis 927
Poecilocerus 216
Polistes hebraeus 647
Polyalthia longifolia 489
Polycarpae corymbosa 491
Polydora 474
Polydora testudinum 473, 475

PAGE
Polydorus aristolochiae aristolochiae 366
Polygala 488
Polygala erioptera 490
Polygonum 315, 488, 891
Polygonum aviculare 521
——— hydropiper 521
——— nepalense 110
——— plebejum ... 487, 508, 512
Polyommatus icarus chitralensis ... 823
——— loewii sanoga 822
——— orbitulus 822
——— ——— ellisi 822
——— ——— jaloka ... 822
——— ——— walli 822
——— poseidion florenciae ... 823
Polypedilum *sp.* 650
Polytela gloriosae 649
Pomatorhinus erythrogenys 29
——— ——— haringtoni 889
——— horsfieldi horsfieldi 751, 752
——— ——— obscurus 751, 752
——— ruficollis ruficollis ... 889
——— schisticeps 751
Pongamia 74
Pongamia glabra ... 741, 521, 522
——— pinnata 521
Pontobdella 474
Porphyrio poliocephalus poliocephalus 411
Portulaca oleracea 491
——— quadrifida 491
Porzana porzana 410
——— pusilla [pusilla] 410
Potamogeton 81
Potamogeton javanicus 81
Potentilla 887
Potentilla fruticosa 310, 887
——— fulgens 665
Pottingera 313
Pouzolzia indica *var.* alienata ... 665
——— ——— angustifolia ... 665
——— pentandra *var.* ramoississima ... 665
Pratapa deva deva 827
——— ——— lila 828
Precis almana almana 370
——— hierta hierta 370
——— iphita iphita 819
——— ——— pluviatalis ... 370, 819
——— ——— siccata 819
——— lemonias vaisya 370
——— orithiya 370

PAGE
Premna racemosa 665
Prenolepis 260, 262
Presbytis 598
Primula 310
Primula petiolares 314
Prinia 246
Prinia buchanani 763, 766
——— gracilis 766
——— ——— gracilis 765
——— inornata 753, 766
——— inornata terricolor 764
——— lepida 765
——— socialis 753
——— ——— inglisi 567
——— sylvatica gangetica 764
——— ——— sylvatica 764
——— ——— valida 764
Prionailurus bengalensis 290
Pristarthria minutella 649
Procarduelis nepalensis 893
——— rubescens 893
Prodenia litura 649
Prosopis ... 397, 450, 452, 487, 754
757, 758, 788, 793
Prosopis juliflora 486, 496
——— spicigera ... 312, 375, 403, 488,
496, 512, 741, 742, 743,
758, 785
Prothoe calydonia belisama 817
——— franckii angelica 817
Proxenus melanospila 649
Prunella immaculata 41
——— modularis 42, 613
——— rubeculoides 613, 614, 928
——— strophiata strophiata ... 891
Prunus 309
Prunus amygdalus 522
——— ——— *var.* amara ... 522
——— ——— ——— dulcis ... 522
——— armeniaca 522
——— avium 522
——— cerasoides 523
——— ——— rubella 307
——— cerasus 523
——— mahalab 523
——— padus 523
——— persica 523
——— puddum 523
Psammogeton biternatum 499
Psara licarsisalis 649
Psarisomus dalhousiae... 58

PAGE

Pseudibis papillosus 386
Pseudobranchellion margoi ... 474, 475
Pseudogyps bengalensis 67
Pseudoraphis aspera 659
Psidium guayava 497
Psittacula cyanocephala bengalensis... 433
——— eupatria nipalensis... ... 432
——— krameri borealis 432
Psychoda alternata 649
Pterocarpus marsupium 376
Pterocles exustus ellioti 427
——— indicus 427
——— orientalis 427
——— senegallus 428
Pterodroma aterrima ... 334, 339, 343, 347
Pteronemobius 550
——— bicolor 551
——— birmanus 550
——— concolor 550
——— csikii 55, 648
——— fascipes 551
——— gravelyi 550
——— taprobanensis 551
——— vagus 550
Pteroplatea 833
Pteruthius erythropterus 33
Ptyas mucosus 609
Ptyon oprogne rupestirs 928
Puffinus assimilis 337
——— carneipes 342, 344, 346
——— lherminieri persica ... 336, 337, 339
——— pacificus 336, 337, 342, 344, 345
——— ——— chlororhynchus ... 343
346
——— *sp.* 336, 342
Punica granatum 497
Pupalia lappacea 487, 507
Pycnarmon cribrata 649
Pycnonotus cafer humayuni 744
——— ——— pallidus 744
——— ——— pusillus 744
——— ——— vicinus 744
——— jocosus (fuscicaudata) ... 745
——— leucotis leucotis 745
——— luteolus 616
——— ——— luteolus 745
Pygeum gardneri 524
Pyralis manihotalis 649
Pyrrhocorax graculus 612, 927
——— pyrrhocorax ... 612, 927

PAGE

Pyrrhocorax pyrrhocorax himalayanus ... 887
Pyrrhula erythrocephala 893
——— subhimachala 893
Pyrus 314, 315
——— aucuparia 526
Quercus 312, 313, 316
——— lamellosa 314
——— pachyphylla 314
Rahinda hordonia 370
Rallus striatus (albiventer) 410
Ramphalcyon capensis capensis ... 575
——— ——— gurial 575
Rana 938
Rana beddomii 635, 858, 938, 939
——— breviceps 620, 623, 637, 638
——— leithii ... 635, 636, 852, 938, 939
——— leptodactyla 856, 857
——— semipalmata 856, 857
——— temporalis 636, 858, 939
——— tigrina 637, 639
Ranunculus cabulicus 489
——— muricatus 489
Rapala abnormis... ... ... 803, 829
——— dieneces dieneces 829
——— melampus 373, 829
——— pheretimus petosiris 829
——— varuna lazulina 829
——— ——— orseis 829
——— ——— schistacea 829
Raphanus sativus 490
Raphimetops ablutella 649
Rathinda amor 372
Rattulus 625
Rattus mulleri 470
——— rajah 470
——— rattus kandianus 860
——— ——— rufescens 860
——— sabanus 470
——— whiteheadi 470
Rauwolffia canescens 660
Recurvirostra avocetta avocetta ... 422
Rehderodendron 316
Reseda odorata 490
Rhabdia lycioides 308
Rhabdochona uca 945
Rhineodon 331, 332
Rhineodon typus 326, 623
Rhinoceros sondaicus ...83, 85, 273, 274, 302
——— sumatrensis ... 274, 302
Rhipidura 758

PAGE
Rhipidura aureola aureola ... 748, 749
——— ——— compressirostris ... 748
——— pectoralis 749
——— ——— pectoralis ... 749
——— ——— vernayi 749
Rhizoclonium 349
Rhizophora 75
——— candelaria 75
——— mucronata 69, 75
Rhizosolenia alata ... 113, 118, 119, 122
——— bergonii 113, 119
——— calcar-avis ... 113, 119, 122
——— delicatula ... 113, 119
——— imbricata ... 113, 122
——— robusta ... 113, 119, 122
——— setigera ... 113, 119, 122
——— stolterfothii ... 113, 118, 119, 122
——— styliformis ... 113, 122
Rhododendron ... 309, 310, 313, 314, 315, 316, 886
Rhododendron anthopogon 887
——— arboreum ... 886, 888
——— arizelum ... 315, 316
——— barbatum 886
——— campunulatum... ... 887
——— chryseum 316
——— dendricola 312
——— falconeri 314
——— genesterianum 313
——— grande 314
——— polyandrum 315
——— simsii 305, 316
——— sino-grande ... 314, 316
——— stenaulum 313
——— telopeum (?) 315
——— tephropeplum 315
——— trichocladum 315
Rhodoleia forrestii 313
Rhodophila ferrea 37
Rhopodytes tristis 65
——— viridirostris 435
Rhus 312, 488
——— punjabensis 106
Rhyacornis fuliginosa 38, 613
——— ——— fuliginosa ... 891
Rhynchina pervulgaris 649
Rhynchoglossum obliquum 109
Ricinus communis ... 185, 323, 509, 524
Riparia paludicola chinensis 735
Rivea ornata 503

PAGE
Rivula biocularis... 964
Rodgersia 315
Rohtee cotio 626, 627, 628
——— vigorsii 626, 627, 628
Rosa 308, 886
Rosa damascena 497
——— involucrata 308
——— omeiensis 310
Rostratula benghalensis benghalensis 422
Rotifer... 625
Rucervus duvaucelli 870
Rumex hastatus 508
Ruppia 6
Rusa unicolor 867, 870
Rynchospora 82
——— wallichiana 82
Saccharum 512
Saccolepis indica... 222
——— myosuroides 222
Salix 310
Salix tetrasperma 308
Salpina 629
Salpornis spilonotus rajputanae ... 783
——— ——— spilonotus ... 783
Saluenense 310
Salvadora... ... ... 14, 375, 762, 765
Salvadora oleoides ... 375, 487, 501, 742, 743, 785, 792
——— persica ... 375, 488, 501, 745, 785
Salvia aegyptiaca 506
Samadera 72
Samadera indica 72
Samanea (Pithecolobium) saman ... 645
Sanicula europaea 107
Sapium indicum 524
Saponaria vaccaria 491
Sarcogyps calvus 66, 399, 795
Sarkidiornis melanotus melanotus ... 391
Sasia ochracea 61
Saxicola caprata atrata 774
——— ——— bicolor ... 774, 890
——— torquata 37, 890, 927
——— ——— indica 775
Saxicoloides 768
Saxicoloides fulicata 618
——— ——— cambayensis ... 769
Saxifraga 310
Scapsipedoides 548
——— apterus 548
——— macrocephalus ... 548

PAGE
Scapsipedus ... 547
Scapsipedus asperus ... 547
———— ceylonicus ... 547
———— mandibularis ... 547
Scenedesmus ... 349, 625
Schima ... 312, 313, 314
Schleichera oleosa ... 524
———— trijuga ... 376, 524
Schoenobius bipunctifer ... 649
Sciara *sp.* ... 650
Sciurus (= Callosciurus) erythraeus
  intermedius ... 860
——— variabilis ... 860
Sclerostachya fusca ... 660
Scoliodon ... 838, 839
Scoliodon acutus ... 832
——— palasorrah ... 832, 834, 838
——— sorrakowah ... 832, 833, 834, 835, 838, 839
——— walbeehmi ... 832, 838
Scolopax rusticola rusticola ... 420
Scopula cleoraria ... 951
——— idearia ... 649
——— octuaria ... 649
Scottia ... 551
Scottia ceylonica ... 551
Scutellaria ... 308
Scylla serrata ... 946
Scyllium canicula ... 833
Seicercus burkii burkii ... 892
——— castaniceps ... 53
——— xanthoschistos ... 52
——— ——— xanthoschistos ... 893
Selenastrum ... 349, 629
Semnopithecus ... 598
Semnopithecus entellus ... 285
Senebiera pinnatifida ... 490, 660
Serinus canarius ... 55
Sesamia inferens ... 649
Sesamum alatum ... 657
——— ekambaramii ... 657
——— indicum ... 185, 323, 504, 525
——— laciniatum ... 657
——— orientale ... 525, 657
——— prostratum ... 657
Sesbania aegyptiaca ... 495
——— cannabina ... 660
——— paludosa ... 664
——— uliginosa ... 664
Seseli indicum ... 664

PAGE
Sesuvium portulacastrum ... 665
Setaria ... 488
Setaria intermedia ... 185, 322
——— verticillata ... 511
Seychellesia ... 559
Seychellesia ceylonica ... 559
Shorea ... 312
Shorea assamica ... 307
——— robusta ... 460, 461, 462
Siccia guttulosana ... 649
Sida acuta ... 492
—— carpinifolia ... 492
—— cordifolia ... 492
—— rhombifolia *var.* rhomboidea ... 492
—— veronicaefolia ... 491
Siegesbeckia orientalis ... 108
Sinapis dichotoma ... 490
Siphia parva ... 42
—— strophiata strophiata ... 892
Sisymbrium orientale ... 660
Sitta ... 783
Sitta castanea cinnamoventris ... 26
—— frontalis ... 27
—— ——— frontalis ... 787
—— himalayensis ... 888
Siva strigula strigula ... 889
Smilax ... 312
Solanum dulcamara ... 525
——— melongena ... 226, 228, 504
——— nigrum ... 503
——— tuberosum ... 504
——— xanthocarpum ... 503
Solenopsis ... 260
Sonchus asper ... 664
——— oleraceus ... 500
Sonneratia ... 69, 76
Sonneratia apetala ... 69, 361
——— caseolaris ... 76
Sophora mollis ... 526
——— tomentosa ... 526
Sopubia *sp.* ... 185
Sorbus ... 309, 314
Sorbus aucuparia ... 526
——— harroviana ? ... 315
——— insignis ... 315
——— microphylla ... 887
——— pygmea (?) ... 310
Sorghum ... 511, 762, 791
Sorghum vulgare ... 375
Sorgum ... 222
Spaligis epius ... 371

Page
Spatula clypeata ... 390
Spergula arvensis ... 491
——— pentandra ... 491
Spermacoce ... 488
Spermacoce hispida ... 499
Sphaeroderma *sp.* ... 859
Sphenarches caffer ... 324
Sphenocercus apicaudus ... 68
Sphenoclea zeylanica ... 664
Sphyrna ... 839
Sphyrna blochii ... 832
——— zygaena ... 382
Spilanthes acmella ... 664
Spilornis cheela cheela ... 402
——— ——— minor ... 401
Spinacia oleracea ... 508
Spindasis ictis ictis ... 372
——— lohita lazularia ... 827
——— vulcanus vulcanus ... 372
Spiraea ... 310, 887
Spiraea auruncus ... 93
Spirogyra ... 349, 625, 629
Spirulina ... 629
Spizaëtus cirrhatus cirrhatus ... 395
——— nipalensis ... 67
Spodoptera mauritia ... 649
Spondias ... 312
Sporobolus *sp.* ... 185, 322
Stachyridopsis ruficeps ... 29
Stachyris nigriceps ... 29
Stachys sericea ... 109
Stachytarpheta indica ... 505
Staphoblemmus humbertiellus ... 548
Staurastrum ... 349, 625, 629
Staurogyne glauca ... 660
Stauroneis ... 625
Streblus *sp.* ... 185
Stellaria media ... 526
Stenachria elongella ... 324
Stephanopyxis turris ... 113, 119, 122
Stephoblemmus ... 548
Sterculia ... 312
Sterculia coccinea ... 312
Sterna albifrons ... 426
——— ——— albifrons ... 426
——— ——— saundersi ... 426
——— anaethetus ... 335, 338, 344
——— aurantia ... 426
——— bergii ... 338
——— fuscata ... 344
——— hirundo ... 390

Page
Sterna melanogaster ... 426
Sterrha lineata ... 649
Stoparola melanops styani ... 892
Streptopelia chinensis ... 68, 297
——— ——— suratensis ... 431
——— orientalis ... 297, 896, 930
——— ——— meena ... 429
——— risoria ... 297
——— risoria rosoria ... 430
——— senegalensis ... 297
——— senegalensis cambayensis 431
——— tranquebarica tranquebarica ... 430
Striga densiflora ... 664
——— orobanchoides ... 504
Strix ocellata ocellata ... 439
Strobilanthes ... 308
Strobilanthes acuminatum ... 665
——— auriculatus ... 223
——— ——— edgeworthiana... 223
——— dyerianus ... 223
——— jeyporensis ... 233
Stromateus cinereus ... 623
Strychnos colubrina ... 526
——— nux-vomica ... 527
Strymon mackwoodi ... 825
Sturnia malabarica ... 55
Sturnus malabaricus [blythii] ... 795
——— pagodarum ... 796
——— roseus ... 795
——— vulgaris poltaratzskii ... 796
Styrax ... 312, 313, 314
Styrax grandiflora ... 312
Sueda nudiflora ... 9
Sula leucogaster ... 344
Surendra amisena ... 827
——— quercetorum biplagiata ... 372
Surniculus lugubris ... 64
Suastus gremius gremius ... 373
Sus cristatus ... 296, 867
Suya atrogularis ... 54
——— criniger ... 53
——— ——— criniger ... 893
Swertia angustifolia ... 108
——— lurida ... 108
Sylvia althoea ... 758
——— borin ... 31
——— communis icterops ... 377, 757
——— curruca blythii ... 758
——— ——— minula ... 758

PAGE
Sylvia hortensis jerdoni ... 757
—— nana nana ... 757
Symplocos ... 313, 314, 315, 316
Synantherias sylvatica ... 90
Synciera traducalis ... 649
Synedra ... 349, 625
Synedrella nodiflora ... 660
Syntarucus plinius ... 371
Syntomis passalis ... 649
Sypheotides indica ... 412
Syrichtus galba ... 373
Syrrhaptes tibetanus ... 930
Tabellaria ... 349, 625
Tabernaemontana dichotoma ... 101
Taccocua ... 435
Taccocua leschenaulti leschenaulti ... 435
—— —— sirkee ... 435
Tagiades litigiosa litigiosa ... 373
Tagetes erecta ... 500
—— patula ... 500
Taiwania ... 311, 318
Taiwania cryptomerioides ... 318
Tajuria cippus cippus ... 372
Talicada nyseus ... 371
Tamarindus indica ... 375, 496
Tamarix ... 487
Tamarix aphylla ... 491
—— articulata ... 491
Tapena thwaitesi hampsoni ... 373
Taractocera ceramus ceramus ... 373
Taraktogenos kurzii ... 102
Tadorna ferruginea ... 389
Tadorna tadorna ... 389
Tarsiger chrysaeus chrysaeus ... 891
Tatera indica cuvieri ... 184, 189, 321
Taxus ... 311, 315
Taxus baccata ... 527
Tecomella undulata ... 504
Tectona grandis ... 459, 461
Teinopalpus imperialis imperialis ... 805
Telchinia violae ... 370
Telmatoscopus albipunctatus ... 649
Temenuchus pagodarum ... 618
Tephrodornis gularis ... 47, 377
—— pondicerianus pallidus 739
—— —— pondicerianus ... 739
—— virgatus ... 743
—— —— pelvica ... 739
—— —— sylvicola 738, 739
Tephrosia ... 487, 488

PAGE
Tephrosia candida ... 21, 528
Tephrosia purpurea ... 495
—— tenuis ... 495, 664
—— villosa ... 495
Terminalia ... 312
Terminalia arjuna ... 375, 497
—— glabra ... 497
—— myriocarpa ... 307, 312
—— tomentosa ... 376
Teramnus libialis *var.* mollis ... 665
Terpsiphone paradisi leucogaster ... 750
—— —— paradisi ... 750
Tesia castaneocoronata castaneocoronata ... 890
Tetracentron *sp.* ... 314
Tetraceros quadricornis ... 870
Tetragnatha ... 874, 875, 877
Tetragnatha cochinensis ... 875, 876
—— gracilis ... 875
—— mackenzieii ... 875, 876
—— mandibulata ... 875, 876
—— viridorufa ... 875
Tetraogallus ... 896
Tetraogallus himalayensis ... 615
—— tibetanus ... 930
Tetrapedia ... 349, 625
Tetrastichus *sp.* ... 649
Teucrinum *sp.* ... 185
Thalasseus bergii *spp.* ... 426
Thalassionema nitzschioides 118, 119, 123
Thalassiothrix frauenfeldii 116, 118, 119, 125
—— longissima ... 116, 123
Thalassochelys corticata ... 474, 476
Thalictrum rostellatum ... 106
Thauria aliris intermedia ... 817
Thelca duma duma ... 825
—— vittata ... 825
Thevetia neriifolia ... 501, 528
—— peruviana ... 528
Threskiornis melanocephalus ... 386
Thrips gossypicola ... 951
—— palmi ... 951, 952
Thuja orientalis ... 512
Tichodroma muraria ... 613, 890, 927
Tilapia ... 147
Tilapia mossambica ... 146, 349, 959
Tinospora cordifolia ... 489, 528
Tockus birostris ... 207, 399, 448, 868
Toddalia aculeata ... 312
Tofieldia ... 310
Trachelobdella ... 474

PAGE
Trachypithecus phayrei phayrei ... 269
——— ——— pileatus shortridgei ... 269
Tradesc tia malabarica 658
Treron curvirostra nepalensis 895
——— phoenicoptera chlorigaster ... 428
Trianthema 488, 498
Trianthema crystallina ... 487, 498
——— monogyna ... 487, 498
——— pentandra 498
Tribulus terrestris 437, 493, 512
Trichodesma amplexicaule 660
——— indicum 502
Trichogaster pectoralis 147
Trichosanthes anguina 493
——— cucumerina 498
Tridactylus 540
Tridactylus ceylonicus 542
——— curtus 541
——— flavimaculatus 541
——— japonicus 541
——— nigripennis 541
——— nigroaenus 541
——— nitobae 542
——— opacus 547
——— quadrimaculata 541
——— riparius 541
——— thoracius 542
——— variegatus 541
Tridax procumbens 487, 500
Trifolium pratense 107
Trigonella corniculata 495, 664
Trigonidium 551, 552, 554
Trigonidium cicindeloides 552
——— humbertianum ... 552, 950
Trigonidomorpha 554
Tigonidomorpha fuscifrons 554
Trigonotylus dohertyi 648
Trilocha fieicola 951
——— varians 649
Tringa cinerea [cinerea] 419
——— erythropus 417, 931
——— glareola 418
——— hypoleucos 419
——— nebularia 418
——— ochropus 418, 931
——— stagnatilis 418
——— totanus eurhinus 417
Triticum 511
Tritetrabdella 469
——— ———ens scand 469

PAGE
Triumfetta rotundifolia 492
Trochalopteron affine affine 888
——— erythrocephalum ... 28
——— phoeniceum 29
——— setifer 888
——— variegatum variegatum ... 888
Troglodytes troglodytes nipalensis ... 890
Tropaeolum majus 493
Tropidonatus stolatus 395
Trygon 833
Tryphactothrips rutherfordi 951
Tsuga 311
Tubiflora acaulis 505
Turdoides 246
——— caudata 754, 761
——— ——— caudata 754
——— malcolmi 754, 755
——— somervillei 433
——— ——— orientalis ... 754
——— ——— ——— < >
sindianus 753
——— ——— sindianus ... 754
——— ——— somervillei ... 753
Turdus atrogularis 40
——— boulboul 39
——— citrina cyanotus 770
——— ericetorum 46, 51
——— merula 40
——— ——— albocinctus 39
——— ruficollis 40
——— simillimus mahrattensis ... 770
Turnix maculatus tanki 409
——— sylvatica dussumier 409
——— ——— taigoor 408
Tylophora 79
Tylophora tenuis 79
Tyto alba stertens 439
Uca ... 702, 703, 705, 706 707, 708, 710, 711, 714, 715, 716
Uca annulipes ... 703, 704, 705, 708, 710, 712, 713, 714, 715
——— beebei 713
——— consobrinus 711, 712
——— manii 945
——— marionis ... 705, 706, 707, 708, 709, 711, 712, 713, 714
——— ——— nitidus ... 705, 711, 715, 716
——— pugillator 706, 713
——— pugnax 707, 712

PAGE
Uca signatus ... 706, 711, 712
—— stenodactyla ... 713
—— stylifera ... 713
—— tangeri ... 712
Udaspes folus ... 373
Udea martialis ... 649
Uperodon ... 638
Uperodon globulosum ... 637
Upupa epops ... 65, 614
—— —— ceylonensis ... 447
—— —— epops ... 447, 895
—— —— orientalis ... 447
Urena lobata ... 492
Urochloa ... 153
Urochloa mosambicensis ... 153
—— reptans ... 185, 322
Urocissa flavirostris ... 25
—— —— flavirostris ... 887
Uroloncha malabarica ... 399
—— punctata ... 55
—— striata ... 55
—— —— acuticauda ... 893
Uromastix ... 397
Ursus ... 598
Ursus arctos ... 598
Uropeltis macrolepis ... 213, 901
—— —— mahableshwarensis ... 901
Utethesia pulchella ... 649
Vaccinium ... 309, 312
Vaccinium glauco-album ... 315
—— modestum ... 310
Valeria ceylonica ... 368
—— valeria hippia ... 368
Valeriana hardwickii ... 108
Vanessa antiopa yendanula ... 810
—— cardui ... 370
Vangueria spinosa *var.* mollis ... 665
Ventilago gamblei ... 660
—— lanceolata ... 660
Veratrum ? ... 310
Verbascum thapsus ... 529
Verbena officinalis ... 109
Vernonia ... 312
Vernonia anthelmintica ... 96
—— cinerea ... 499
Veronica agrestis ... 109, 660
—— anagallis ... 660, 664
Viburnum ... 314, 315
Vicia sativa *var.* angustifolia ... 529, 660

PAGE
Vigna catiang ... 185, 323
Vinca rosea ... 501
Viola ... 309, 310
Viola biflora ... 106
—— cinerea ... 490
Vipera russelli ... 397
Viscum album ... 665
Vitadenia australis ... 108
Vitis ... 312
Vitis heyneana ... 494
—— lanceolaria ... 664
Vivia innominata ... 661
Volvox ... 349
Vulpes bengalensis ... 290
Waltheria ... 72
Waltheria indica ... 72, 492
Withania somnifera ... 503, 529
Woodfordia ... 788
Woodfordia fruticosa ... 743, 789
Xanthium strumarium ... 108, 500
Xenorhynchus asiaticus asiaticus ... 386
Xiphirhynchus ... 788
Xya japonica ... 541
—— obscura ... 541
Ypthima baldus madrasa ... 815
—— hubneri ... 369
Yuhina gularis ... 30
—— —— gularis ... 889
—— occipitalis ... 30, 889
Yungipicus nanus semicoronatus ... 59
Zamenis mucosus ... 187, 189
Zanthoxylum ... 312
—— *sp.* ... 314
Zea ... 511
Zea mays ... 222, 958
zeylanicus (Megalaima) ... 575
eylonicus (————) ... 575
Zephyranthes carinata ... 110
Zesius chrysomallus ... 827
Zizeeria lysimon ... 376
—— otis decreta ... 371
—— trochilus putli ... 371
Zizyphus ... 375, 428, 487, 743, 754, 765, 792
Zizyphus jujuba ... 11, 375, 494, 761
—— nummularia ... 494
—— oenoplia ... 793
—— rotundifolia ... 494
—— rugosa ... 494
—— xylopyrus ... 494

PAGE
Zoothera marginata 40
Zosterops palpebrosa 55, 57
——— ——— occidentis ... 789
——— ——— sálimalii ... 789

PAGE
Zygaena blochii 835
Zyras bicolor *spp.* 649
—— indorum 649

PRINTED AT THE DIOCESAN PRESS, MADRAS—1958. C10000

5.06.54

JOURNAL OF THE BOMBAY NATURAL HISTORY SOCIETY

Vol. 52, No. 1

Editors
SÁLIM ALI, H. SANTAPAU

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CONTENTS OF VOLUME 52, NO. 1

PAGE

WILD LIFE PRESERVATION—KRUGER NATIONAL PARK, AN EXAMPLE. By A. St. J. Macdonald. (*With six plates*) 1

OBSERVATIONS ON THE DIET OF FLAMINGOES. By M. W. RIDLEY ... 5

A NEW SANDLARK FROM WESTERN INDIA (SAURASHTRA). By C. Vaurie and K. S. Dharmakumarsinhji 8

ON THE OCCURRENCE OF EPHEDRA IN THE INDIAN DESERT. By M. M. Bhandari. (*With one photograph*) 10

SOME BREEDING BIRDS OF SINGAPORE, PART III. By W. T. Loke. (*With five plates*) 14

A CONTRIBUTION TO THE ORNITHOLOGY OF THE DARJEELING AREA. By M. D. Lister. (*With a text figure*) 20

BACKWATER FLORA OF THE WEST COAST OF SOUTH INDIA. By C. Rajasekhara Mudaliar, M.A., and H. Sunanda Kamath. (*With a text figure*) 69

A NOTE ON THE POSITION OF RHINOCEROS IN THE UNION OF BURMA. By U. Tun Yin 83

POISONOUS SEEDS OF INDIA, PART I. By S. L. Nayar 88

A CONTRIBUTION TO THE FLORA OF MUSSOORIE. By N. A. Watts ... 106

PERIODICITY OF THE PLANKTON DIATOMS OF THE CHILKA LAKE FOR THE YEARS 1950 AND 1951. By J. C. Roy. (*With two maps and two text figures*) 112

GROWTH-RATE OF THE PEARL OYSTER (*Pinctada pinctada*) IN THE GULF OF CUTCH WITH A NOTE ON THE PEARL FISHERY OF 1953. By S. V. Gokhale, C. R. Easwaran and R. Narsimhan. (*With five text figures*)... 124

CRITICAL NOTES ON THE IDENTITY AND NOMENCLATURE OF SOME BOMBAY PLANTS. By R. Fernandes, B.SC. and H. Santapau, S.J. (*With two plates*) 137

THE DEVELOPMENT OF CEYLON'S FISHING INDUSTRY. By E. R. A. de Zylva. 142

THE GENUS *Cymbopogon* SPRENG, IN INDIA, BURMA AND CEYLON, PART II. By N. L. Bor. (*With 27 text figures*) 149

NATURAL HISTORY OF THE SOUTH INDIAN GERBILLE (*Tatera indica cuvieri* WATERHOUSE). By M. R. N. Prasad 184

NEW SPECIES OF INDIAN PLANTS. By R. Seshagiri Rao 190

REVIEWS :—

1. Animal Wonderland—Essays in Natural History. By Frank W. Lane. (D.E.R.)... 192
2. Leopard of the Hills. By James Temple. (P.A.G.E.)... ... 192
3. The Birds of Burma. By B. E. Smythies. (C.E.H.) 193
4. Hoofed Mammals of the World. By Ugo Mochi and T. Donald Carter. (S. Thomas Satyamurti) 195

PAGE

5. The Pharmacognosy of Ayurvedic Drugs. Series 1, No. 2. Published by the Central Research Institute, University of Travancore, Trivandrum. (H. Santapau, S.J.) 196
6. The Indian Pharmaceutical Codex, Vol. 1. By Dr. B. Mukerji. (H. Santapau, S.J.) 197
7. The Birds of the British Isles, Vols. 1 & 2. By David A. Bannerman and George E. Lodge. (H.G.A.) 198
8. The Birds of West and Equatorial Africa, 2 volumes. By David A. Bannerman. (H.G.A.) 199

Additions to the Society's Library 199

Miscellaneous Notes :—

1. Man-eating Tiger in South India. By R. C. Morris (p. 201). 2. Panther killed by Domestic Buffaloes. By J. M. Power (p. 201). 3. More notes on the Indian Buffalo. By R. P. Noronha (p. 202). 4. Gaur attacking man. By R. C. Morris (p. 204). 5. Thamin or Eld's Deer (*Panolia eldi thamin*, Thomas) in Burma. By Tun Yin. (p. 205). 6. Stride of Elephant crossing trench. By R. C. Morris (p. 206). 7. Death of Wild Elephants from suspected food-poisoning in Travancore-Cochin State. By N. G. Pillai (p. 206). 8. Birds eating the poisonous fruit of the Yellow Oleander (*Thevetia neriifolia*). By S. M. Krishnan (p. 207). 9. Migration of Insectivorous Birds in Madhya Pradesh in 1953. By C. E. Hewetson (p. 207). 10. Strange behaviour of a House Crow. By C. H. Biddulph (p 208). 11. Possible association between the Large Yellow-naped Woodpecker and the Large Racket-tailed Drongo. By C. H. Biddulph (p. 209). 12. *Cuculus canorus bakeri* in Bombay. By Humayun Abdulali (p. 210). 13. Occurrence of Redwinged Crested Cuckoo (*Clamator coromandus*) in Madras. By S. M. Krishnan (p. 210). 14. Goshawk (*Astur gentilis*) in Bhavnagar (Saurashtra). By K. S. Dharmakumarsinhji (p. 211). 15. Occurrence of the Banded Crake (*Rallus eurizonoides amuroptera*, Jerdon) in Travancore. By M. C. A. Jackson (p. 211). 16. Food of the Bull frog. By T. Gay (p. 212). 17. The Record Indian Crocodile. By Humayun Abdulali (p. 213). 18. An addition to the list of snakes of Bombay and Salsette—*Uropeltis macrolepis* (Peters)—*Uropeltidae*. By V. K. Chari (p. 213). 19. Further comments on the Mani-jal of the Chilka Lake—A special net for Beloniform Fishes. By S. Jones and K. H. Sujansinghani (p. 214). 20. Aposematic Insects and their Food-plants. By D. G. Sevastopulo, F.R.E.S. (p. 215). 21. Aposematic Insects and their Food-plants. By C. McCann (p. 216). 22. Occurrence of *Danais chrysippus* var. *dorippus* at Dum Dum Airport. By A. E. G. Best (p. 218). 23. Hunters' Sugar. By W. S. Thom (p. 218). 24. Occurrence of Corymorpha (*Hydrozoa*) in Indian waters, (*With a text figure*). By M. R. Ranade, (p. 219). 25. A Six-locular Capsule on the Cotton Plant. By G. W. Deodhar (p. 221). 26. Occurrence of a Bi-foliate Leaf in *Citrus aurantium* L. (*With a sketch*). By S. Kalyanasundaram (p. 221). 27. Proliferation in grass. By R. B. Majumdar (p. 222). 28. The flowering of *Strobilanthes auriculatus* Nees. By Mrs. Jamal Ara (p. 223). 29. Abnormalities in the fruit of *Areca catechu* L. (*With a text figure*). By T. S. Ramakrishnan (p. 224). 30. Effect of margosa (*Azadirachta indica*) leaves on the rotting of potato tubers during storage. By S. L. Tandon (p. 225). 31. Variation in the floral parts of *Solanum melongena* L. (*With a text figure*). By G. P. Argikar and M. S. Solanki (p. 226). 32. Chapters on the History of Botany in India, by I. H. Burkill, in this Journal 51: 846–878. A correction. By S. P. Agharkar, (p. 228). 33. Gleanings (p. 228).

Notes and News 231

Corrigenda 232

JOURNAL

OF THE

BOMBAY NATURAL HISTORY SOCIETY

1954 VOL. 52 No. 1

WILD LIFE PRESERVATION— KRUGER NATIONAL PARK, AN EXAMPLE

BY

A. ST. J. MACDONALD

(*With six plates*)

With wild life preservation gaining more attention by both Government and public opinion in India, I feel that my observations on a recent visit to the KRUGER NATIONAL PARK in South Africa may be of interest to those sponsors who have strived so hard in the past, and present, to improve our own Game Sanctuaries.

The Park owes its existence to the foresight of President Kruger, who as far back as 1884 foresaw the destruction that would take place in the Transvaal and other parts of South Africa. It was not, however, until 1898 that part of the present park (the Sabie Game Reserve) received full protection, and in fact the present boundaries covering nearly 8,000 sq. miles from the Limpopo River in the North, to the Crocodile River in the South, and bordering Portuguese territory in the East, extending some 200 miles long with an average width of 40 miles, only emerged with the passing of an Act in 1926, which may be assumed to be the birthday of this great, and now, world popular enterprise and sanctuary of wild life.

I toured nearly 4,500 miles by road through the Union, and it is no small wonder Kruger saw the necessity of this venture. You can travel 500 miles from Durban to Pretoria, or 800 miles from Johannesburg to Cape Town and not see a wild creature of any kind. The few natural trees, and the occasional bird stress the destruction in the march of man's needs, and impel us in this country to take timely warning.

The Reserve.—This is the world's largest wild life sanctuary and is intersected with 1,000 miles of motor roads, and has 14 rest camps varying in size from SKUKUZA with 750 beds, to the smaller camps of GORGE and OLIFANTSRIVIER of only 20 beds, but the average accommodation is 200 beds. Camps are a collection of thatched rondavals

AUG 23 1954

surrounded by a stockade with gates which are shut after dark, and visitors must all be in half an hour before sun-set and gates do not reopen until half an hour after daylight. Every car entering the Reserve (no one is allowed to enter on foot, bicycle, or horse-back), is stopped and briefed in the simple rules to be followed. These are: 'You must not carry firearms or shoot animals; you must not leave the roads; and you must not get out of your car'. Game Wardens are there to see these rules are kept, and the public themselves adhere strictly to the conditions. It is a credit both to the public and the officials, inasmuch as some 14 million visitors have been through the Park since 1926 and there has not been a single accident or attack by wild animals. Some 30,000 visitors from all parts of the world, come yearly to visit the place and it is now run on the takings, without any Government subsidy.

Accommodation.—Besides the indigenous rondavals, the larger camps have small huts and cottages to take families for long periods. Spring mattresses and comfortable beds are provided with camp furniture in all places. Hot and cold water is provided, day and night, bathrooms and showers, and boys to wash up and clean out the huts, with cooking places for the traditional meal in the open of a dry grill, termed braaivleis. The larger camps have Post and Telegraph Offices, Stores, well-provided with provisions, fresh meat, eggs and vegetables, etc., Restaurants, Garages with petrol pumps and Tourist Bureaus.

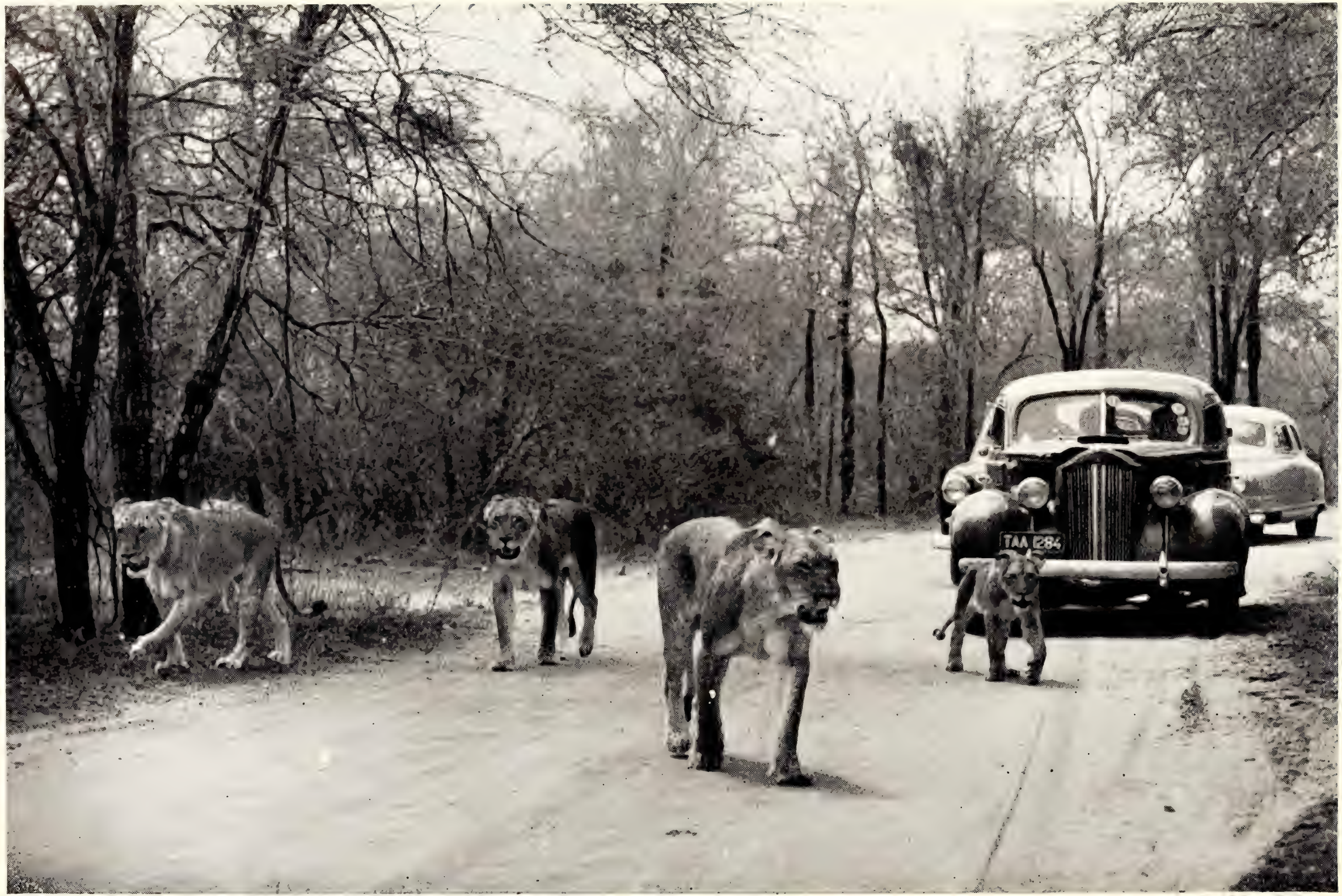
Communications.—The main roads serving the Park are all of excellent quality, and distances of 400 miles are covered in 8 to 10 hours. In the Reserve itself some 1,000 miles of dirt track form a network of communications, traversing all the natural haunts of game, along rivers, swamps, water holes, etc. The maximum speed allowed is 25 miles per hour, but all roads are signed with caution and speed restrictions, where elephants are likely to be encountered and in fact have ridges across the road to stop speed-racing. Any infringement of the law is punishable by fine, and the offender is black-listed and escorted out of the reserve immediately; but this is very rarely necessary, and I was informed by a Game Warden that hardly a case occurred in a season.

Tourist Bureau.—Excellent maps are available, giving the distances between camps, the accommodation available, and illustrating the game likely to be seen. A handbook is also issued with illustrations of the animal on one page and its description, colour, habits, and size on the opposite.

Wild Life.—I have myself done a good deal of big game shooting in my thirty odd years in India and Burma, but this watchful expectancy from a car, compares with any thrill I experienced—awaiting a driven tiger, a rogue elephant, or closing in with a tracked bison or tsine. Should you think that the feeling of peril and risk is absent, I can only assure you that the analysis of feeling is the same, but even more beautiful and thrilling, to see at close quarters, the immutable and blood-red law of nature prevailing, and man is in his car but a spectator, and regarded as no more than some other form of life in the Reserve by the denizens in their countless thousands.

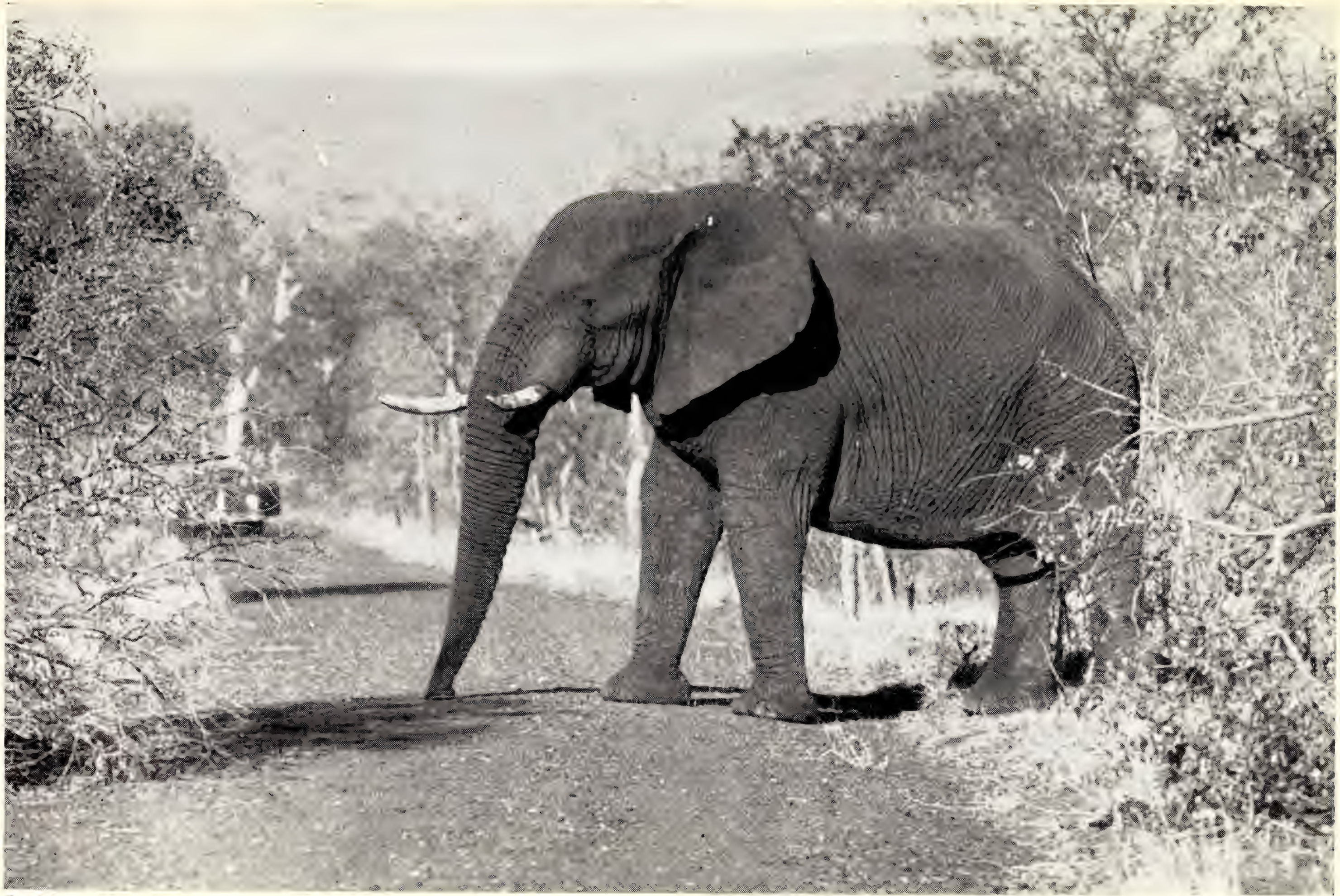
Courtesy *South African Railways*

Lion and Lioness in road.
Kruger National Park, South Africa.



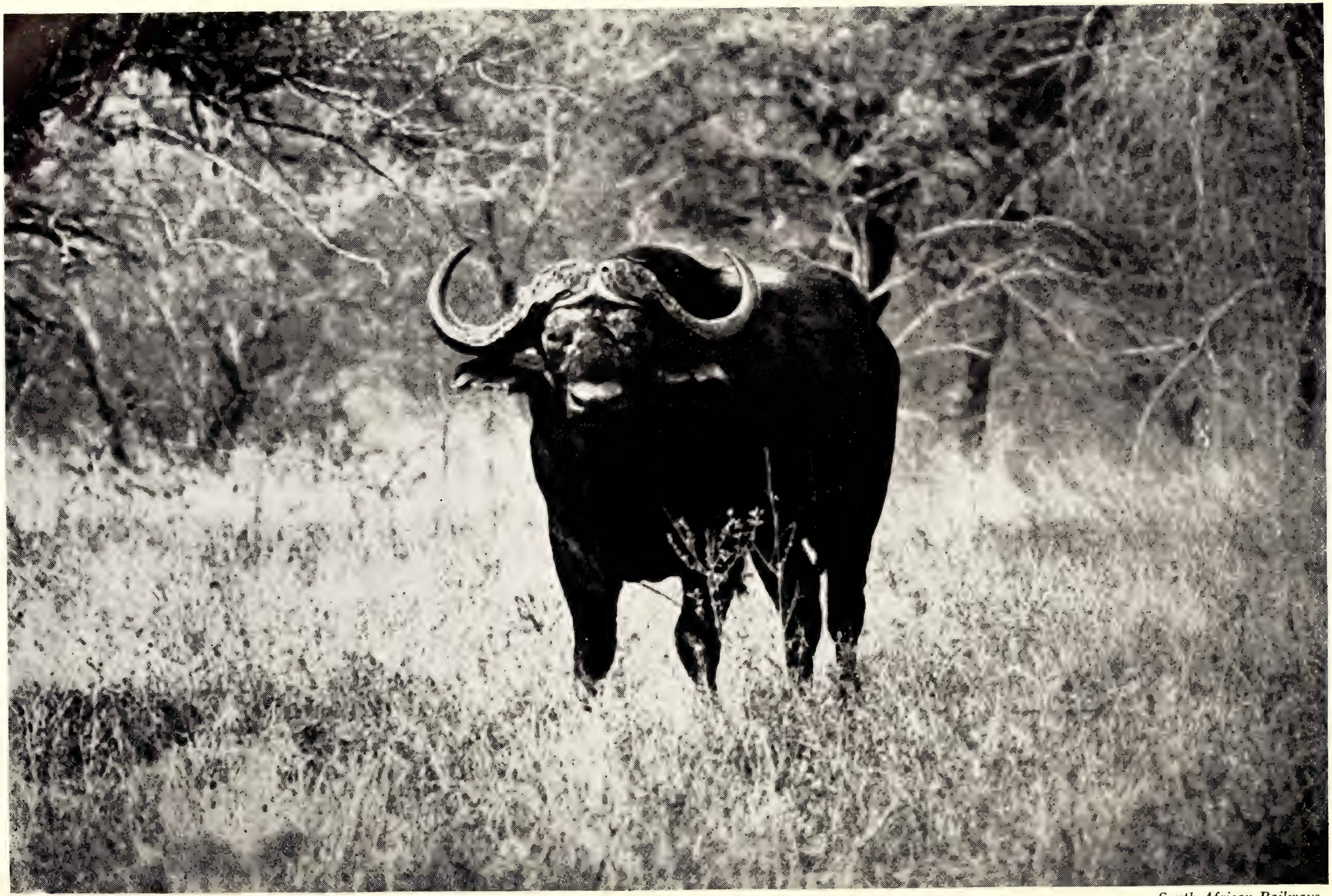
Courtesy *South African Railways*

Lions and Cars.
Kruger National Park, South Africa.



Courtesy *South African Railways*

Elephant crossing road.
Kruger National Park, South Africa.



Courtesy *South African Railways*

Buffalo.

It appeared to me fantastic, that a pride of lions sprawled over the dirt track, accepted conditions as their own, and only moved because they wished, and not because they were disturbed, to let 30 odd cars through.

I spent four days in the Reserve touring the southern portion, and saw countless thousands of Impala, so like our beautiful spotted deer in habit and numbers, in the Hailey Park, and South Mandla, but they are antelope, and like black buck in appearance and size. Stately giraffe look down upon the car from 30 ft. away with the same unconcern and confidence, as kudu, eland, wildebeest, zebra, water-buck, and the beautiful sable antelope; besides, are many of the smaller species, duiker, stein-buck, and those comedians of the Reserve, wart-hog, who trot alongside the moving car with tail erect and the head held high, or dig up roots by the roadside and do not as much as look up at passing cars, so much have animals become accustomed to visitors.

Lions.—To all intents and purposes, lions strike one as domesticated; they will lie on the roads; walk in and out of standing cars; will lie asleep 5 ft. from a car pulled up besides them; feed on a kill and show no resentment to a car alongside packed with chattering women and children; lionesses with young cubs tolerate the same treatment and show no alarm; it is almost unbelievable unless witnessed. Of the 17 lions I saw on one day, one came up through some 30 cars and smelt the boot of the car, then walked by the window of the car from where I could have extended my arm and touched her. At another place we saw two lionesses with very young cubs enjoy a meal off a freshly killed Impala with no concern at the 40 odd cars drawn up three deep on the road beside them.

Elephant.—I saw 88 in two hours, but here one is advised to show caution; and one is left with no doubt in mind, as signs appear everywhere, warning the visitor to drive slowly and carefully because of elephants, and not to approach too close to them. I saw herds of 44; single bulls; and mothers with calves, at distances up to 30 ft.

Buffalo.—Huge herds will cross in 'follow the leader' fashion roads, with cars packed on either side of the gap, with the same confidence of right of way.

Rhino.—In the Hluhluwe Reserve in Zululand, Rhino behave in the same way, and accept motorcars as something new in their world, though one is warned not to approach too close to them.

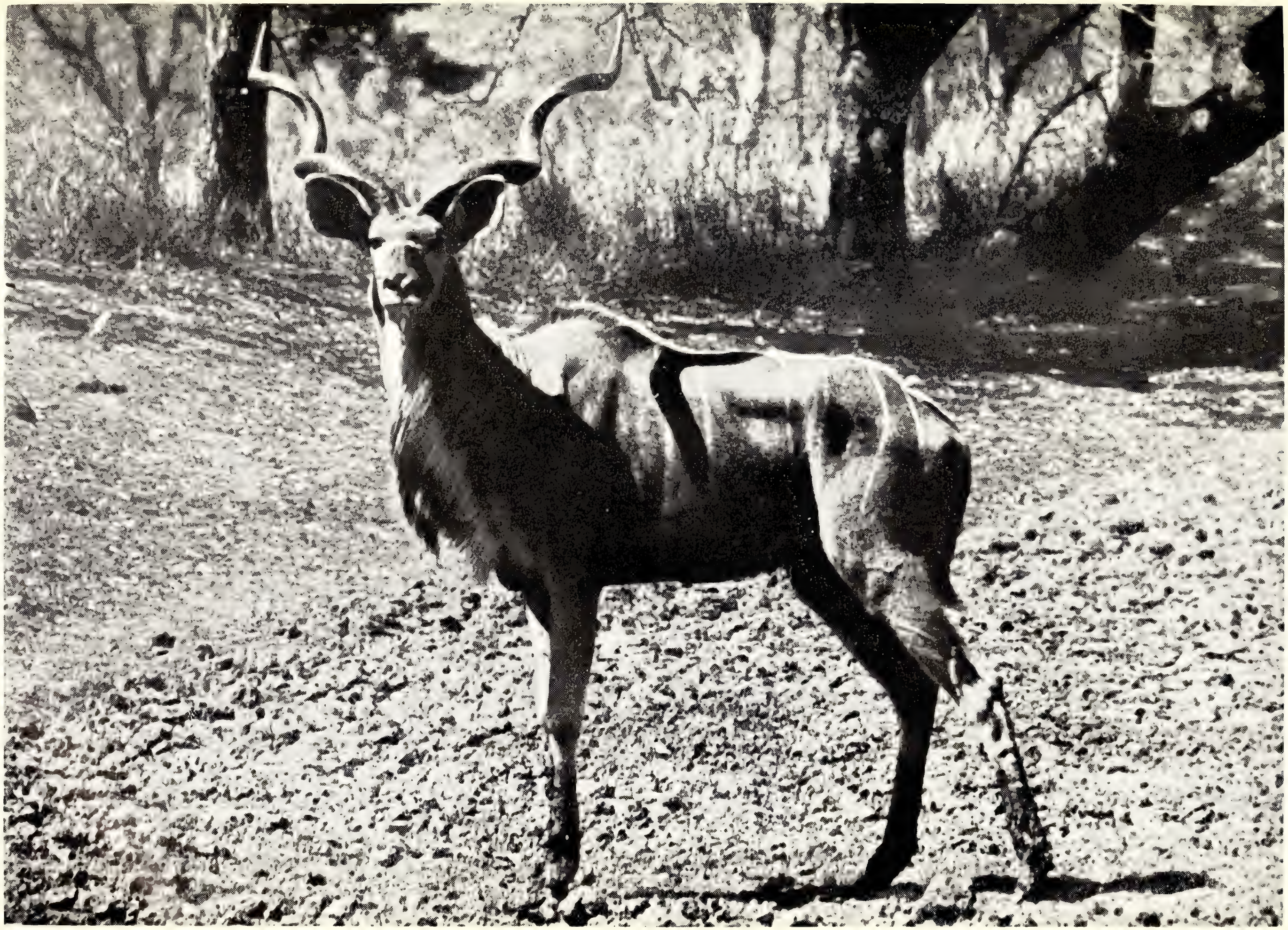
Water-hole.—Here I saw the code of nature at its best, and communication of thought transmitted from one species to the next, of danger. Some 30 cars were parked in line, facing a jungle tank as we would know it, but in Africa water is very scarce, and special tubewells have been installed in parts of the Reserve to provide water by windmill pumps feeding into depressions. A lion had taken up his position in some reeds, which we could all see, awaiting his opportunity to kill.—We saw Impala come down and drink down wind of him, with sentry posted and beating her front feet on the ground in alarm, until relieved by one that had been to water, then came wart-hog, wildebeest, sable, kudu, and zebra. It was all a simple reading of nature; no creature except some yellow-bill duck and teal were up wind of the lion, for as soon as they approached the waterhole, scent warned them of danger and they moved excitedly to the 'down-wind' approach, placed their sentries, and then took of nature's beverage and moved off. But there are suckers in all walks of life, and the zebra is, I think, the best conditioned and most foolish of all Africa game. When the other game were alarmed they all ran up wind, but the zebra herds scatter to all points of the compass, and so fall easy prey; this is what happened on this occasion.

Visitors.—The fellowship and friendliness among visitors, struck me even more than the behaviour of the animals themselves: with some 300 cars passing in a day, never once did we have anyone butting in, or try to jockey for position; a passing car would stop and give information of lions or elephant ahead; ask if they may pass should you be stopped to view some animal, and so on were a host of delightful road manners experienced, sometimes in French or the broken English of a foreigner, or perhaps in broad American or Australian, for there were people in the camp from all parts of the world. This is I think the background of success in this great enterprise, and why the animals have become so tame and accustomed to cars with humans.

Baboons will be seen at places, like beggars, standing on their haunches in some parts of the Reserve, and will walk up to a car if stopped and take from the hand, oranges or biscuits. We had in fact one get into the car through the window, and seat himself behind the driver to enjoy bits of nougat I was cutting up and giving him—I had to open the door and entice him out to get rid of him. He did not snatch but took his fare gently, a big male of 120 pounds appeared quite at home with four of us in the car!! The day is not far distant when antelope will also approach cars to be fed—they already do almost everything else.

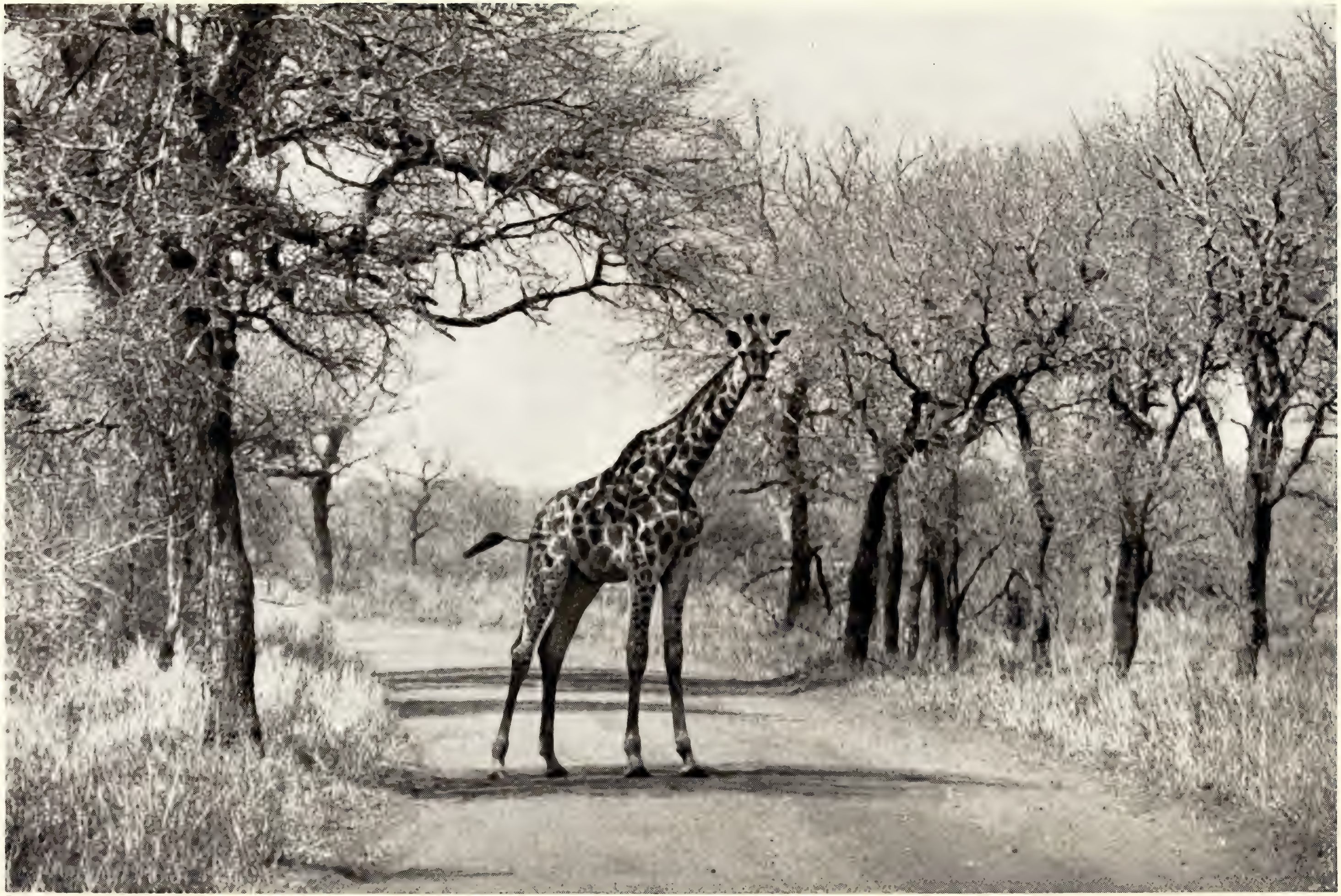
Conclusion.—We can only hope that the day is not far distant when our own great potential of wild life will receive the same measure of security, and our Sanctuaries are organised on similar lines, for there is no country in the world that can boast of the variety of fauna, in such abundance and variety, or forests as extensive and beautiful. Africa has no deer as beautiful as the spotted deer, gond, or sambhur, and the lion does not in my opinion compare with the majestic tiger in beauty or grace, and our elephants are gentlemen compared with his evil tempered African cousin.

I have gone into some length of detail to show the immeasurable charm such a reserve provides, and the softening effect it has on the lust to kill, and the scope for coloured or movie pictures which are far better souvenirs than any trophy hung on a wall.



Courtesy *South African Railways*

Kudu Bull.
Kruger National Park, South Africa.



Courtesy *South African Railways*

Giraffe crossing road.

OBSERVATIONS ON THE DIET OF FLAMINGOES

BY

M. W. Ridley

The following observations were made by the author in Kenya Colony between 1951 and 1953. During these years all the lakes inhabited by flamingoes were visited and specimens collected with a view to the collection of data on the habits, occurrence and natural history of one of East Africa's most colourful, yet least known birds.

In Kenya flamingoes are found on the lakes of the Great Rift valley. The 'Soda' lakes are their real home, and they only seem to occur spasmodically on those lakes with a normal fresh water fauna, e.g. fish and higher plants which (with exceptions such as the small *Tilapia* found in Lake Magadi), cannot exist in the concentrated alkali of the former class of lake. Their headquarters are on Lakes Hannington, Nakuru, Magadi and Elmenteita, which are generally shallow and almost barren of life other than flamingoes. On drying these lakes deposit a layer of white soda (Na_2CO_3), which forms an unpleasant dust. As Africa becomes more arid, these lakes are much lower in level than formerly and, having no outlets, the concentration of salts has in many cases reached saturation point—for example, Lake Magadi where the soda and also Common Salt ($NaCl$) are mined commercially, and Lake Nakuru which is now dry except during the rains. There is evidence that the lower level of water and thus the greater concentration of salts, has resulted in a greatly increased population of flamingoes in Lake Elmenteita.

The most numerous of the two species occurring is the Lesser Flamingo [*Phœniconaias minor* (*Geoffroy*)]. In Lake Hannington, in July 1953, out of a total population of over 2 million, more than 99% were of this species, but when their characteristic food is absent, as it was at Lake Elmenteita in December 1951, the only birds seen are the Greater Flamingo [*Phœnicopterus ruber roseus* (*Pallas*)]. These appear to be largely migratory, spending only the palæarctic winter in Kenya, yet individuals are to be seen throughout the year even as far south as the Union of South Africa. There is, however, no proof of breeding anywhere in the African continent, but it may yet be found to breed somewhere. The lesser species undoubtedly does so but apparently at intervals and only spasmodically, but the author believes that their main breeding place has yet to be discovered.

Observations of the feeding habits and occurrence of the two species were made at most of the lakes, and the gut contents of some forty individuals were examined under the microscope. The results of these examinations are given in detail in a table following this paper.

This table makes it clear that the two different species have substantially different diets, as is borne out by the differences in bill structure, and also in the methods of feeding employed.

The Greater Flamingo's bill is much less highly specialised than the Lesser's and consists of a smaller area of 'straining surface'. These surfaces, chiefly on the upper mandible, (which becomes the lower when the bird is feeding) are composed of parallel rows of 'ridges' or laminae which are visible to the naked eye. Without, in this note, going too deeply into the function of this structure it may be said that the bill of the Greater Flamingo is only capable of straining comparatively large objects out of the water or mud and in this sense may be regarded as analagous to that of a typical duck.

The lesser species, on the other hand, not only possesses a much greater area of straining surfaces but is also much more capable of straining the finer organisms on which the bird feeds, because the laminae or ridges are equipped with fine hairs protruding from them which can effectively sieve objects as small as diatoms.

In feeding, the Greater Flamingo generally though not invariably immerses the whole head and the bill is buried in the mud on the floor of the lake. The head is then swung from side to side with the bill inverted, while the bird walks slowly forwards. The Lesser Flamingo, however, does not normally immerse its head but skims the surface of the water with a semicircular motion, with the bill inverted and the 'upper' mandible just beneath the surface. Either species swims freely in deep water when feeding, and Greater Flamingoes sometimes 'up-end' like swans.

A significant difference in the average size of the grit, which forms a large proportion of the stomach contents has also been noticed, that in the Greater Flamingo being much larger. The function of the grit is to grind the food in the gizzard.

It is concluded from these examinations that the Lesser Flamingo feeds more or less exclusively on blue-green algae and diatoms—and it is noteworthy that the only cases where this does not hold good are those of two birds secured at Lake Elmenteita in 1951, which were both damaged birds unable to fly and therefore left behind by the vast flocks of their species which are normally to be seen there. At this time blue-green algae were noticeably absent from the lake.

The Greater Flamingo, on the other hand, feeds on a great variety of foods, animal as well as vegetable, and from the small number collected it is difficult at this stage to say more. The published literature on the food of this species emphasises the diversity of the diet;—In India, Sálim Ali (1945) recorded the seeds of plants (e.g. *Ruppia*). In France, Gallet suggested that the organic content of the mud in the lagoons of the Camargue might constitute a food supply. In America, the subspecies *Ph. ruber ruber* feeds on the marine snail *Cerithium* (F. Chapman, 1908), but not exclusively so (Zahl, 1953). In the Red Sea the old world subspecies has been recorded feeding on a similar mollusc (Lord W. Percy, *in litt.*). It seems, therefore, that the Greater Flamingo is much less specialised in its diet than the lesser species.

Several observers have commented on the inadequate food supply in the barren, highly alkaline waters of the known breeding grounds of the Greater Flamingo, such as the Camargue, the Guadalquivir delta and the Rann of Cutch. As the author has never visited these places it is dangerous to give an opinion, but it is perhaps worthy of note that:

(1) Flamingoes feed for relatively long periods during the day.

(2) The Flamingo has the longest Meikel's tract of any bird, (Meikel's tract is the absorptive part of the alimentary canal).

(3) There is an immense quantity of rich orange fat, containing carotine, on healthy flamingoes which might act as a reserve of food during the breeding season. Definite conclusions, however, are not attempted here.

The author is hoping to prepare a further paper on flamingoes and would be particularly interested in any observations by members of the Natural History Society of Bombay. Any information about these birds in India—particularly as to diet, breeding and migration—would be most welcome.

DIET OF FLAMINGOES

Table showing results of examination of stomachs

(a) *Greater Flamingo*

Date	Place	Gut contents,
Dec. 1951	Elmenteita	Chiefly Chironomid larvæ ; a trace of Corixids.
Dec. 51	,,	Chironomid larvæ ; a few sedge seeds.
Dec. 51	,,	Chironomid larvæ ; a few Copepods.
Nov. 52 Dec 52	"	Small quantities of Chironomid larvæ, Copepods, Corixids, Sedge Seeds.
Apr. 53	,,	Sedge Seeds. Algæ and Diatoms. Various Insect larvæ.
July 53	Hannington	Higher plant remains (leaves). Insect larvæ.
July 53	,,	Ditto.

(b) *Lesser Flamingo*

Dec. 51	Elmenteita	Abundant Corixids ; Some Chironomids and Seeds.
Dec. 51	,,	Seeds only.
Dec. 52	,,	Blue-Green Algæ (*Myxophyceæ*) (4 Birds examined).
Mar. 53	Naivasha	Diatoms (*Bacillariophyceæ*) (4 Birds examined).
Apr. 53	Elmenteita	Blue-Green Algæ.
June 53	,,	Blue-Green Algæ. (4 Birds examined).
July 53	Hannington	Blue-Green Algæ. (11 Birds examined).
Sep. 53	Rudolf.	Blue-Green Algæ.

From this it appears fairly conclusively that the staple food of *P. minor* is Algae. The exact specific determination of the Algae has not yet been completed, but the genera *Arthrospira* and *Oscillatoria* have been identified, among the Blue-Green Algae, and *Navicula* among the Diatoms.

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A NEW SAND LARK FROM WESTERN INDIA (SAURASHTRA)

BY

C. Vaurie

AND

K. S. Dharmakumarsinhji

On April 26 and June 17, 1953, Dharmakumarsinhji collected five specimens of *Calandrella raytal* at Bhavnagar, Saurashtra, four in April and one in June, which did not correspond in their coloration with the published descriptions of any known populations of this species. These specimens were sent for critical comparison to the Bombay Natural History Society and forwarded by the Society to the American Museum of Natural History in New York. They were examined by Vaurie who could not match them with any specimens in this institution of nominate *raytal* from the Gangetic Plain or of *C. r. adamsi* from the Punjab and Sind. The four specimens collected in April were in very worn plumage and the specimen from June about half way through the moult. Vaurie suggested that, if possible, additional specimens in fresh or unworn plumage be collected. These have now been received, consisting of two specimens in very fresh plumage collected on August 8 and four specimens in relatively little worn plumage collected on November 24. These six additional specimens, like the former, were also collected at Bhavnagar by Dharmakumarsinhji. The series of eleven specimens which shows, therefore, all stages of plumage, indicates clearly that the population of Bhavnagar constitutes a new and very distinct race of *Calandrella raytal* which is described as follows:—

Calandrella raytal krishnakumarsinhji, new subspecies.

Type: Adult female; Bhavnagar, Saurashtra; November 24, 1953, K. S. Dharmakumarsinhji, collector. Deposited in the American Museum of Natural History, New York.

Subspecific characters: Differs from any known populations of the species by being more heavily streaked and much darker in all plumages, dark gray above, not sandy as in nominate *raytal* or *adamsi,* the latter showing occasionally a faint vinous tinge. The dark shaft streaks are broader throughout and the lower throat and breast is more heavily and more abundantly streaked; flanks greyish and faintly streaked, not whitish or buffy and unstreaked as in the other two races. Bill short and thick as in *C. r. adamsi* but blackish above and below, not horn color above, and yellow at the base of the mandible as in specimens of *adamsi* or nominate *raytal* collected in recent years.

Measurements: Type, adult female, wing 78.5, tail 45, bill from skull 13. Other specimens: Wing, tail, and bill respectively, males, 82, 45, 13; 82+, 47+, 13; females, 76+, 43, 12.5; 78, 42, 12.8; 78+, 42+, 13; unsexed, 79, 45, 13 (very fresh), 85, 50, broken (very fresh), 81+, 44+, 13.5; 82+, 47+, broken; 83, 44+, 13. Range, 11 adults, wing 76-85 (80+), tail 42-50 (47+), bill (9 specimens) 12.5-13.5 (13.0).

Range: Known so far only from the type locality.

Ecology and Field Notes: These notes, given below, are observations made by Dharmakumarsinhji.

We take great pleasure in dedicating this new lark in honour of His Highness Raol Shri Krishnakumarsinhji, the Maharaja Saheb of Bhavnagar.

Field Notes

This bird is common at Bhavnagar where it is found on the marine mud flats which extend 14 miles each way from Bhavnagar. The soil of these flats varies from brown to dark muddy-brown and becomes very dark when wet by the tide (Vaurie finds that the correlation in coloration is very good between a sample of this soil and the plumage of the birds). The vegetation, where present, consists of marine grasses and of the small 'Morad' plant (*Sueda nudiflora*). The bird is very confiding, allows close approach, and tolerates human and railway traffic to the extent of nesting close to the rails. During the breeding season it is found in twos or threes and at other times in flocks of 10 or 20 birds. It makes short flights and walks easily.

The nesting season lasts from March to September, the principal months being June to September during the onset of the monsoon. The nest is a fairly neat cup, made of grasses, string, or other such material and is placed on the ground often under the protection of the small 'Morad' plant. Some nests were hidden under discarded and dried husks of coconuts. Most of the nests found had been built on the railway embankment which faces to the northwest but in spite of their greater protection from the southwest monsoon, many were destroyed by the heavy rains. The clutch consists of two to three eggs which are whitish, spotted with light or dark brown markings, more heavily so on the broad end.

The male, when giving its courtship song, which is sweet and melodious, sings on the ground and while he sings erects his crown feathers and flutters his wings sideways. At other times he flies a little way up and descends after a short song. Occasionally, males may be seen sparring with wings outstretched and crown feathers erected. The common call note is a *cheruk-cheruk* which is so characteristic of the bird that it immediately identifies it at any distance.

ON THE OCCURRENCE OF *EPHEDRA* IN THE INDIAN DESERT

BY

M. M. BHANDARI

(*With one photograph*)

Much confusion exists as regards the occurrence of *Ephedra* in the Indian Desert. In the following brief note the occurrence of *E. foliata* Boiss. has been reported in many diverse habitats, in different parts of the Indian Desert. Reasons have been enumerated for the incorrect identification of the climbing specimens of *Calligonum polygonoides* Linn. by Blatter and Hallberg which most probably were the *E. foliata* Boiss. plants.

Ephedra is a small low-growing, xerophytic shrub, belonging to the family *Gnetaceae*. Many species of this plant have been reported to occur in India. Watt (1890) describes three species; according to him only *Ephedra peduncularis* Boiss. 'a tall scandent shrub, with slender branches, grows on the stony grounds in Rajputana.' Brandis (1906) recognised five species occurring in India, but he does not mention any one of them occurring in Rajputana. Blatter and Hallberg (1918) in their 'Flora of the Indian Desert' mention that King (1879) reported *E. foliata* Boiss. from Jaisalmer in his 'Sketch of the Flora of Rajputana'. They also mention Miss Macadam (1890) having reported *E. foliata* Boiss. from this area (no definite locality given). According to her the Marwari name is *Lana*. According to Talbot (1949) *E. peduncularis* Boiss. occurs in the plains of Rajputana often growing gregariously, forming dense clumps of brushwood, in very

dry and arid situations. Ramchandra Rao (1941) reported the occurrence of *E. vulgaris* Rich. in the desert areas of Rajputana, where it is called '*Lana*'.

Recently, I found many plants of *E. foliata* Boiss. growing in different habitats in many parts of the Indian Desert. I first discovered this plant growing as a large climber with thick stem and pendulous branches, on *Zizyphus jujuba* Lamk. at the village Bapini (27°3′N. lat. and 72°90′E. long.). It was next recorded at Tapu, a village nearly 15 miles to the south of Bapini, growing along with *Mimosa rubicaulis* Lamk. and *Lycium europaeum* Linn. on large sand dunes. At Bhikamkor (26°78′N. lat. and 72°68′E. long.) six plants were noticed. Some of them growing as the Bapini specimen and others were like the Tapu specimen but climbing on *Gymnosporia montana* Benth. This occurrence of the plants at the diverse places led me to believe of the wider occurrence of this plant. Naturally on my return to Jodhpur I explored the environs of Jodhpur, and twenty plants, growing miles apart, were located. The first plant observed was growing gregariously in a stone quarry of the 'Massuria Hill' 2 miles west of Jodhpur. Several new offshoots were noticed, coming out all round the main rhizomatous stalk, which itself was covered with small stones and pebbles. Near Balsamand 4 miles north of Jodhpur and at Chopasani Bund 5 miles west of Jodhpur the plants observed were large climbers with pendulous branches, growing along with *Cocculus villosus* DC. and *Boerhavia verticillata* Poir, etc. on *Gymnosporia montana* Benth. Out of the 5-6 plants later observed near Akhey Rajji's Tank, one of them was climbing on *Euphorbia royleiana* Boiss. while others were on *Gymnosporia montana* Benth. The habits of the various specimens observed so far have been recorded in the table below, along with localities, their supports if any and the nature of substratum, for comparison :—

S. No.	Localities	Habit	Support	Nature of Substratum
1	*Bapini* ...	Large climber	*Zizyphus jujuba*	Gravel
2	*Tapu* ...	Gregarious	With *Mimosa rubicaulis* & *Lycium europaeum*	Sand dunes
3	*Bhikamkor* ...	Climber and Gregarious	*Gymnosporia montana* & *Mimosa* & *Lycium* sps.	Gravel and sand dunes
4	*Jodhpur*–			
	Massuria ...	Gregarious	No support	Rocky
	Balsamand ..	Climber	*Gymnosporia montana*	Gravel
	Umed Bund ..	Climber	*Gymnosporia montana*	Gravel
	Akhey Rajji's Tank.	Climber	*Gymnosporia montana* & *Euphorbia royleiana*	Gravel

Ephedra grows in association with thorny plants. Out of these *Gymnosporia montana* Benth. being the most thorny offers a nice anchorage, as well as protects the *Ephedra* plants from camels, which are very fond of it.

Blatter and party who visited this area in 1917 did not report *Ephedra*, even though they probably visited almost all these localities. Such a keen and critical observer as Blatter could have hardly missed *Ephedra*. A very interesting fact which may be correlated with this omission by Blatter and party is their record of two climbing specimens of *Calligonum polygonoides* Linn. which in their own words 'is a habit quite different from the usual appearance of the plant when growing on sand dunes'. I also visited at least one out of the two spots (sand dunes near railway station at Bhikamkor), where Blatter and Hallberg found the so-called climbing specimen of *Calligonum polygonoides* Linn. and I found no such climbing *Calligonum* plant. Moreover the inquiries made from the local villagers, convinced me that *Calligonum polygonoides* Linn. is never a climber. Naturally the so-called climbing specimens of *Calligonum polygonoides* Linn. reported by Blatter and Hallberg, were *Ephedra* plants. The following arguments support this assumption:—

1. The local Marwari name of *Calligonum polygonoides* Linn. is '*Phogro*' whereas that of *Ephedra* is *Suvo Phogro* (*Phogro* with dull green colour; in Marwari *suvo* is the colour of the parrot). It can therefore well be imagined that the local name which probably Blatter and Hallberg were given, might have been the cause of this incorrect identification, since there is only a difference of degree rather than of kind in the two local names.

2. Both these plants have many similarities: Leafless stems, articulated and jointed branches with a characteristic dull green colour and similarities of ochreate stipules and dried scale leaves. When only the vegetative morphology is studied, one may be easily mistaken for the other.

3. Blatter and party visited this place in the month of November when neither of the two plants is in the reproductive phase. In vegetative morphology they are not very different from each other as has been pointed out above. In both these plants flowering sets in January and fruits remain up to March in this area.

4. The rainfall in the area is scanty and precarious. Generally the rains fail. Fruits and flowers of both these plants are eaten by the natives in the lean years. Even in ordinary seasons they are consumed as human food. This information itself might have led to incorrect identification.

5. It seems improbable that the plant is a recent introduction. *Ephedra* is a slow grower and almost all the plants found are very old. Some of the plants are more than a century old.

It therefore appears that the plants noted by Blatter and Hallberg were really *Ephedra* plants. These plants have been identified with the help of the key given by Gupta and Bal (1952).

It is a prevalent view that *Ephedra foliata* Boiss. has either no alkaloid contents at all, or only in negligible quantities; but according to Chopra (1933) the greater the rainfall of the place where *Ephedra* grows, the smaller is the alkaloid content, and which would imply that on the contrary, the drier the place the higher the content. For this reason since the Indian Desert is a very dry place and *Ephedra* is common there, it may be of interest to re-analyse the plant; the preliminary qualitative analysis performed in the Botany Department of this College by Prof. Shanti Sarup, (unpublished) has shown encouraging results.

I am very grateful to Prof. Shanti Sarup, M.A., M.SC., for his keen interest and encouragement in the preparation of this note. I am also indebted to Rev. Fr. H. Santapau, S.J., for kindly going through the manuscript and making valuable suggestions.

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SOME BREEDING BIRDS OF SINGAPORE

BY

W. T. LOKE

PART III

(*With five plates*)

[*Continued from page* 800 *of Volume* 51 (4)]

The Longtailed Tailor-bird (*Orthotomus sutorius maculicollis*)

Gibson-Hill, in his 'Checklist of the Birds of Singapore Island', calls the Longtailed Tailor-bird '. . . the commonest tailor-bird in our area.' In the breeding season, the nest is easily found, the birds giving away its location by the excited scolding which greets anyone who goes near. Usually placed close to the ground, it presents no great problems for the photographer. The problem, rather, is how to 'freeze' the rapid movements of the birds when they visit it. Only once have I found a nest more than 5 ft. high; it was placed in a young tree Gardenia (*Gardenia tubifera*), and was about 12 ft. high; two large leaves had been sewn together and formed a very stiff-looking, purse-shaped nest.

The neat little olive-green bird, with the red head, and the long tail which is constantly raised stiffly above its back, is easily recognised; and if not, its noisy ways will soon betray its presence. The Tailor-bird is well named for, as we all know, the nest is made by sewing together a single large leaf, or several leaves, to form a kind of funnel into which the cup-shaped nest is placed. I had always believed that the funnel was made first, after which the bowl of the nest would be formed inside; a nest which I found at Loyang, however, first had the completed cup stitched to the underside of a large leaf, and only afterwards were the sides of the leaf drawn down and around it.

In places where large-leafed plants are scarce, the Tailor-bird will make do with only the cup, and will construct a nest like that of the Fantail Warbler (*Cisticola*). Sálim Ali, noticing the presence of Tailor-birds in the arid country of Kutch, drew the conclusion that, because of the 'scarcity of suitable large-leafed plants, the Tailor-bird may be obliged to build a different type of nest also—a purse of woven fibres as its relations the Wren-Warblers usually do'. Confirmation of this deduction came in a manner which cannot fail to delight the heart of the admirers of Eha. One day, after Sálim's book on Kutch had been written, Eha's son generously presented a copy of Barnes' 'Birds of Bombay Presidency' to the Bombay Natural History Society. Looking through the volume, I came upon a note, in the master's own handwriting, which said,

'Found a pair building their nest at the end of a pendent branch of the narrow-leafed *Salvadora* so common in this sand-hill country.

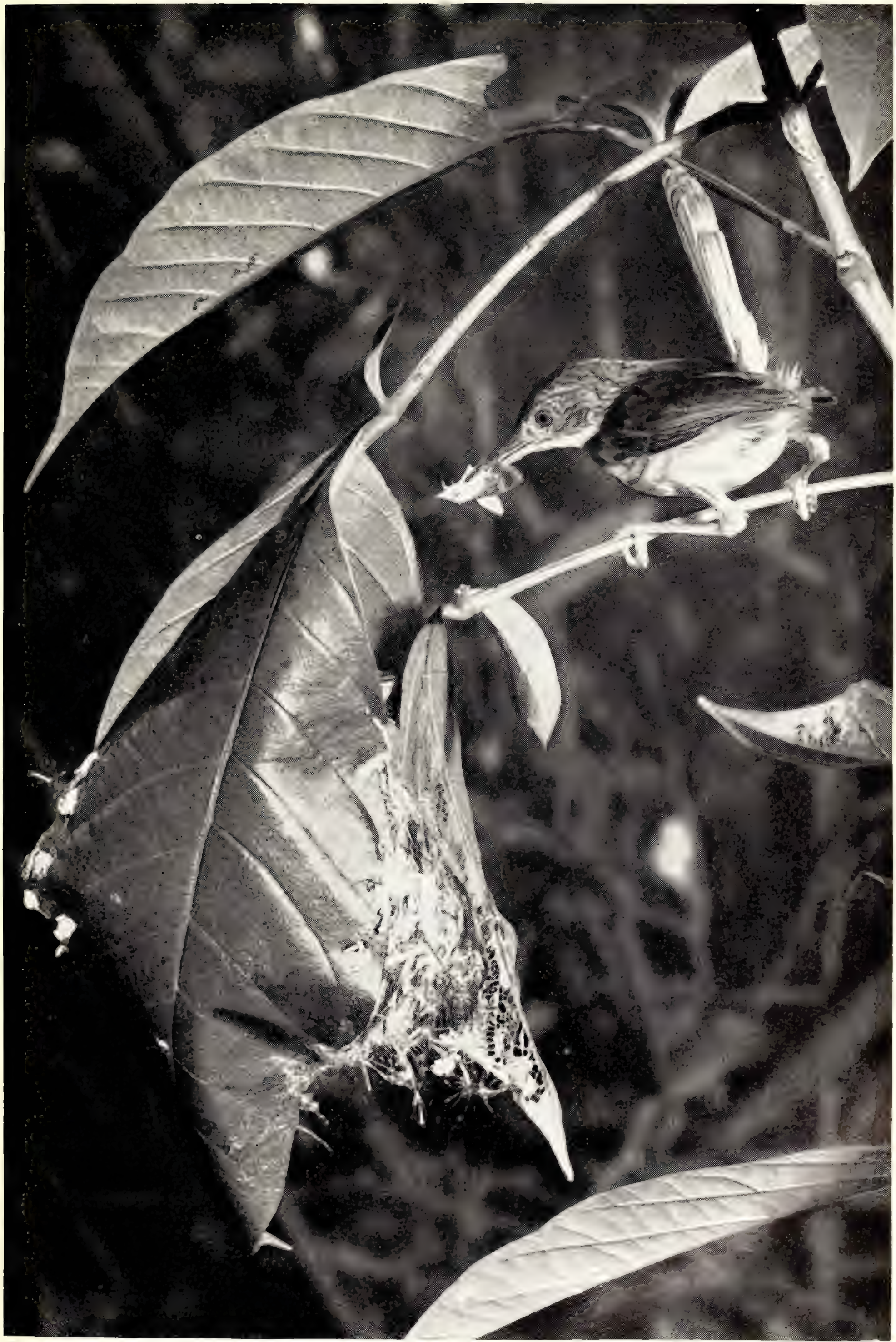

Photo *W. T. Loke*

Longtailed Tailor-bird.
(*Orthotomus sutorius maculicollis*).

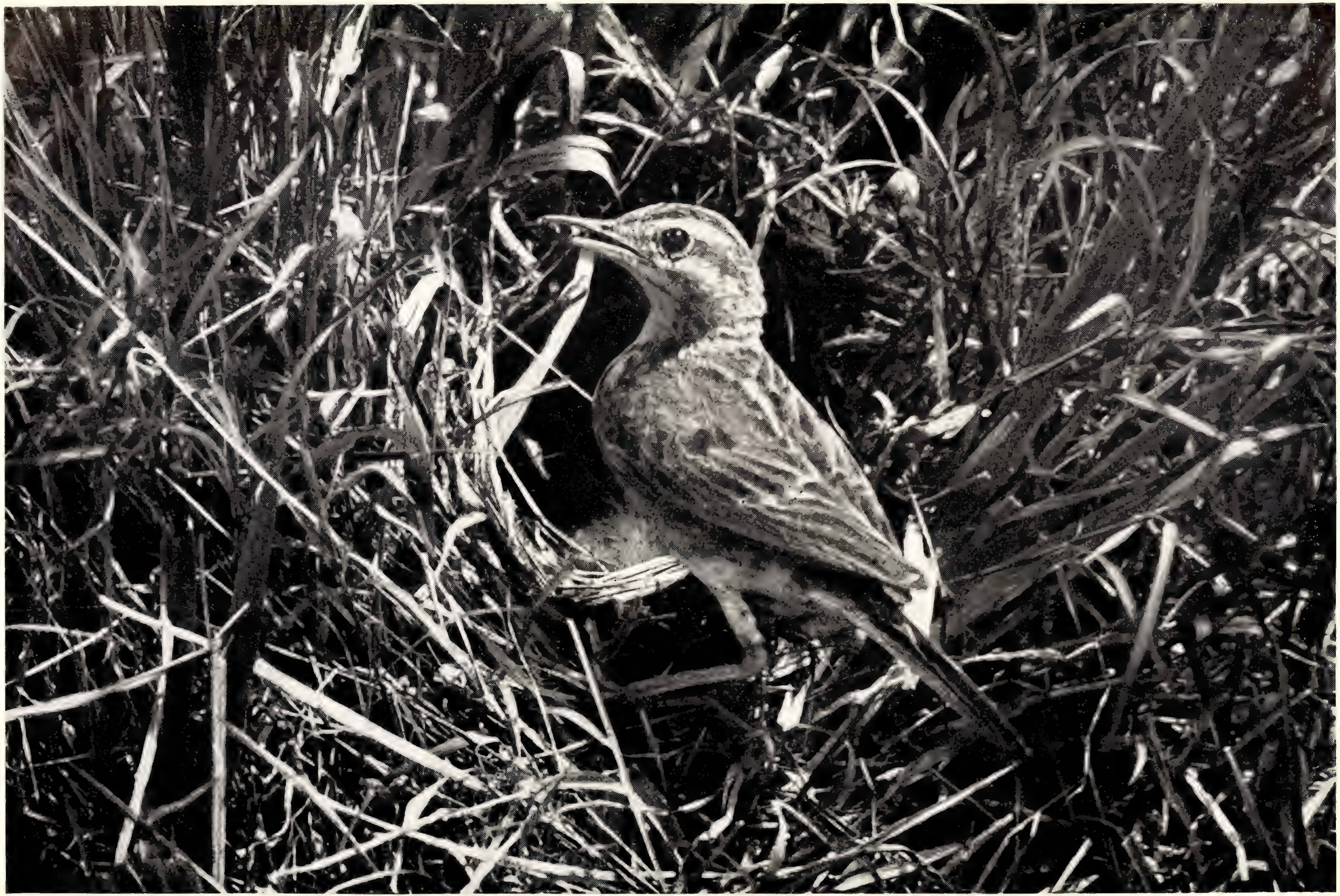

Photo *W. T. Loke*

Malay Pipit.

It was woven, like the nest of a *Cisticola*, of various kinds of vegetable down, a number of leaves being sewed to it at the sides as supports. It was about 2 ft. above the ground. Dilyar in Sind. 28-2-1904.

'I have got a nest in a rose bush. Ten leaves are more or less sewn to it, but the nest is an independent structure woven of something very like ordinary cotton wool and bound about with white fibrous threads, some of which pass from one leaf to another, being sewn into both. There were eggs in the nest when found. Kurrachee 22-4-1904.'

This quite unexpected confirmation of Sálim Ali's theory delighted both Sálim and myself, and a reference to it was added to the 'Birds of Kutch' in the form of a footnote.

The Longtailed Tailor-bird usually lays a clutch of three or four eggs, and these are deposited at intervals of one day. The eggs are of a pale blue ground-colour, heavily marked with reddish-brown. The incubation period is 12 days, and the young birds leave the nest 14 days after they are hatched. My data concerning incubation and length of stay in the nest is derived from observation at only one nest, so that it must not be taken as the final word for all Tailor-birds of this species.

Any bush, or tree, with a large leaf seems to be suitable for nesting. I have, for instance, found a nest in a canna plant: the stalk had been damaged so that it was bent over until it touched the ground, and the Tailor-bird's nest suddenly found itself a mere 6 inches above the earth. We put a ring of little stakes round to protect it, and had the satisfaction of seeing the entire brood reared to maturity.

Both parents feed the young, and meals are served frequently, sometimes as often as every 2 or 3 minutes. The watcher is not always able to identify the nature of the food, but I have noticed small caterpillars, grasshoppers and once, so I thought, an ant. Sometimes, an insect too big to be easily swallowed is brought, and the parent bird finds it difficult to push it down the throat of the immature bird. When this happens, the adult will make soft, anxious, chirruping noises, at the same time giving the morsel a good hard shove. Somehow or other, this camel of a morsel always manages to force its way through the needle-eye of the little bird's mouth.

The nests I have seen have all been found in the months of July and August.

Malay Pipit (*Anthus novaeseelandiae malayensis* Eyton)

Singapore possesses only one species of Pipit, and it is a resident bird which haunts open country where the grass is not too long. Like other citizens of this island, the Pipit is very fond of a golf course where, during unsuccessful tussles with Colonel Bogey, I have had many opportunities to observe him.

Pipits are usually quiet little birds which do not fly more than is necessary, enjoying, as a rule, taking to their heels as much as to their wings. Their long legs are admirably suited to a quick scuttle through the grass, and the upright carriage of the body well adapted to a good view across open country. In the mating season, however, they will take to the air and fly for hours on end, uttering at the same time a monotonous and quickly-repeated 'Pit-pit-pit-pit' as they show off to their mates on the ground.

The display flight resembles that of the Wagtail, except that the Pipit flies much higher. The wings are fluttered quickly as the bird climbs upwards. At the top of the climb, which may be fifty to one hundred feet in the air, height is maintained for a short time, then the bird dives suddenly earthwards, executing many deft turns and changes of direction as it rushes headlong towards the ground. A variation of this display was once seen by me in the month of February (24-2-1946) when a bird flew into the air with tail raised high, and the wings arched and beating rapidly. It was very worried by our presence and, had we looked for it, a nest would in all probability have been found nearby.

Notes quoted in the 'Checklist of the Birds of Singapore Island', record 'eggs from March to June, with nests found under construction in February and a fledgling seen in July'. On March 2nd, I found a nest containing a fully-fledged young, with another of the same brood discovered in the grass close by. Their parents were feeding them with grasshoppers which indeed appeared to be the principal diet for all Pipits in that neighbourhood.

I have found most nests in the months of March, April and May. Three eggs formed the usual clutch, but I have also seen nests containing two eggs. The latest breeding record I possess is a note of a bird seen in a display flight on the 12th of May.

The majority of nests are made in the form of a round cup but I have, on several occasions, also seen domed nests. The Island Club's golf course is a favourite breeding place where, at the height of the nesting season in April, nests may be found at roughly 100 yds. apart. The grass face of a bunker, or the side of a raised tee, are often chosen as nest sites.

The Yellowbreasted Sunbird (*Leptocoma jugularis microleuca*)

The Old-world version of that New-world wonder, the Humming Bird, is the Sunbird. The birds belong to two different families and are in fact not related, but their small size, bright colours and active movements, and the superficial resemblance they bear to one another, makes it easy for the layman to confuse the two. I once won a prize in an American photographic competition with a picture of a Sunbird in flight. When the editor of the magazine published the photograph, he drew his readers' attention to the mistake in nomenclature which had been made. Mr. Loke, said the editor, had called his bird a Sunbird when in reality it was quite clear that it could not be anything else but a Humming Bird.

Of the good things that come in small packages, surely one of the most charming and attractive must be *Leptocoma jugularis*. Singapore is fortunate to have as a regular inhabitant this bundle of vibrant energy. I have a specially soft spot in my heart for it because, every year since I have lived in my house, 'Mallaig', in Gallop Road, Singapore, a pair of Yellowbreasted Sunbirds have

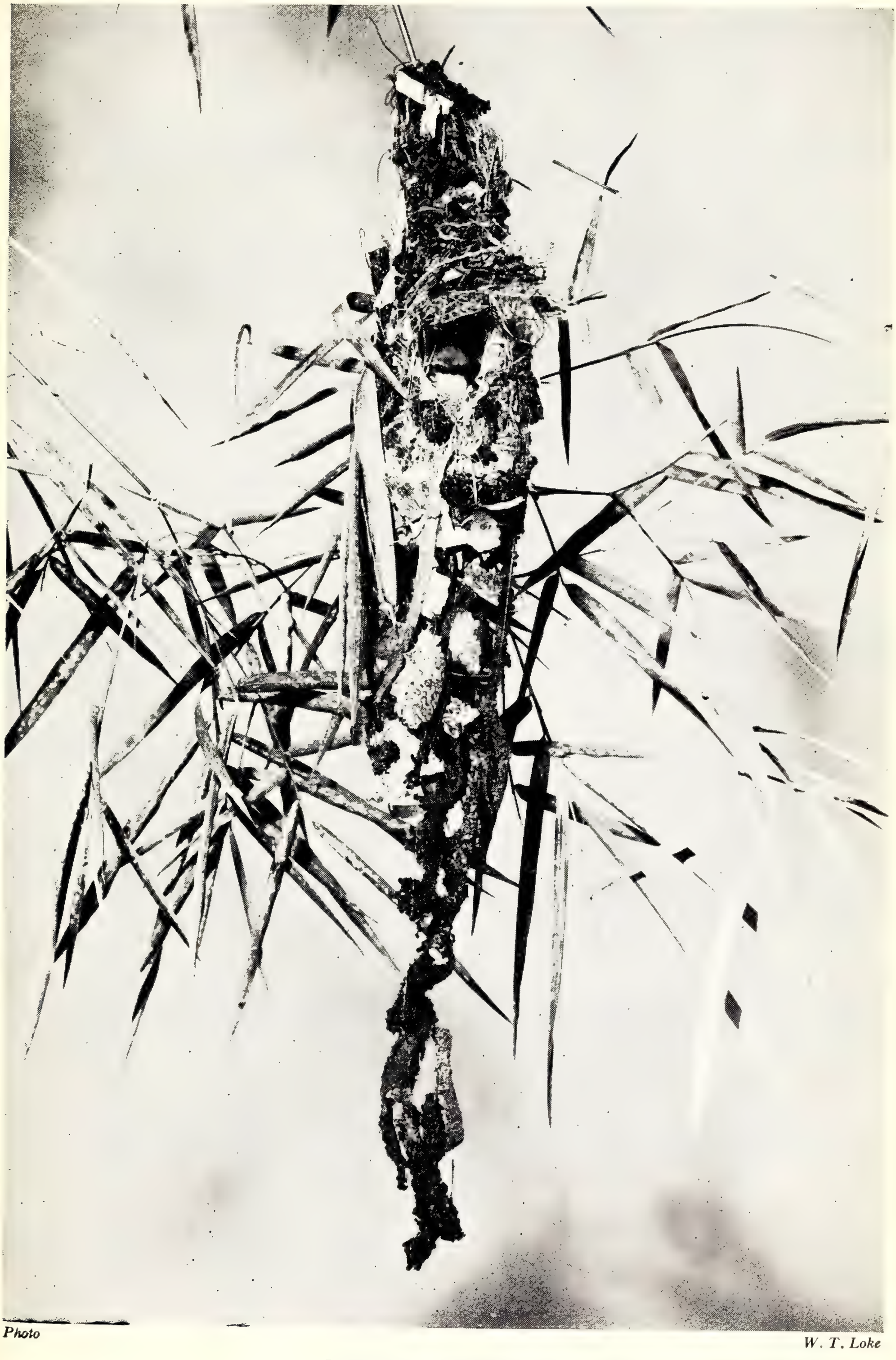

Photo W. T. Loke

Yellowbreasted Sunbird
(*Leptocoma j. microleuca*)
on newly completed nest.

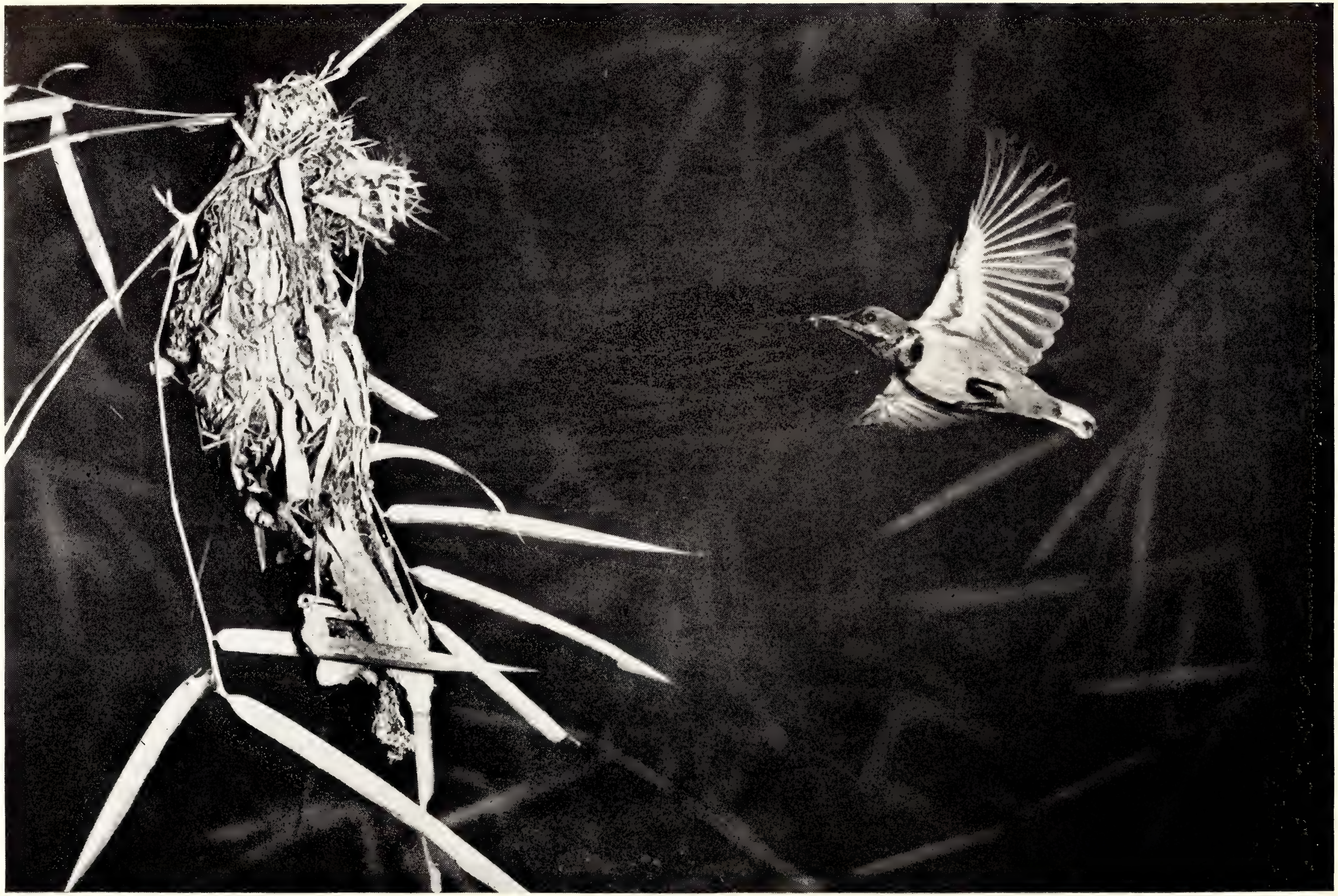

Photo W. T. Loke (Speedflash)

Yellowbreasted Sunbird.
(Leptocoma jugularis microleuca).

never failed to hang their nest in a clump of bamboos which grows outside my bedroom window.

The Sunbird nests early. By the end of December, or early January, a pair of them will be seen inspecting the bamboo clump, and chattering to each other as if this desirable residence were an entirely new find: (I have no evidence to prove it, but it is not unreasonable to assume that the same pair return to nest for several consecutive years). The first hint that my old friends are paying me another visit is when their voices are heard outside; and I know that plans for a family are well under way when they begin to collect cobwebs from the corner of the building next to the large airconditioning machine. The hen does most of the hard labour, now as later, and she makes a cheerful 'chick-chick-chick' as she proceeds about her work.

Sometimes she will collect cobwebs, and at other times will fly down to the ground and tear a beakful from the soft, white, cottonwool seed-head of the lallang.

Her movements are rapid, and once work has begun in earnest on the nest, it takes shape quickly. A spot near the end of a bamboo twig, on the sheltered and shady side of the clump, is chosen. The elongated pear-shaped nest, (Hume in a fit of utilitarian phraseology once called it a 'pendent elongated egg'), is securely anchored by a thick, woven rope of grass. The bird spends a lot of time on this part of the structure, tying it tightly so that it will remain secure even in the strongest wind. The rest of the nest is then added, and some ten days after the first beginnings, the form which it will finally assume is clearly visible. The long 'tail', disguised with leaves, flakes of tree bark and caterpillar droppings, is already attached, and the canopy over the entrance has begun to take shape. By this time, the bottom of the nest chamber is beginning to look quite solid, although its upper part appears tenuous and frail, and daylight may be seen through it.

The bird spends a great deal of her time now bringing materials for the lining. Much of it consists of the soft, downy seed of the lallang. Every so often, she will sit inside and turn in a circle with the object of rounding out the lower half of the nest chamber. Sometimes she will sit with her beak projecting out of the entrance, and with wings slightly opened will move vigorously from side to side, pushing out the walls of the nest, and shaking it so unmercifully that the human watcher begins to wonder if it will stand the strain. No doubt this rough treatment is her method of testing the stress and load factors of a structure which must endure for many months, and which may see the raising within it of as many as four families in one season.

The bird works with great concentration. An entry in my diary for the 27th January, 1952, reads, '10.06 hours: ♀ returns with material for interior of nest. Shows no hesitation, but with a quick jab puts the material in place. Bird seems to have decided beforehand where to put the next beakful.'

January 27th, 1952, incidentally, was Chinese New Year day, and my diary records that at 10.25 I went downstairs to take a quick look at the preparations to receive the morning's guests, but at 10.39 was back at my post. At 11.13, a sad note records, 'Session ends here. First New Year guests arrive'. The tiny bird, working so busily outside my bedroom window was having to keep an eye on her affairs, as indeed I was having to keep an eye on mine, but little did she realise that no new year gift has ever been more welcome than the one she gave me that day.

The cock bird, at this stage, takes little part in the proceedings, but he is not far away, and hangs around to admire his wife's industry. He stands sentry, and when a pair of Yellowvented Bulbuls who, on occasion, have built their nest in this same bamboo clump, visit it with a squatter look in their eyes, the male scolds them loudly. And who is to say that the cock is not serving a useful function? After all, in any scheme of defence, the sentry is a very important person.

Before the nest is completed, 'decorations' are added. Flakes of bark, leaves, a string of caterpillar dropping, are bound to the outside by a liberal use of cobwebs. One of the last jobs to be done is the canopy over the entrance, so giving to the entire structure that little extra touch of artistry which makes this 'pendent elongated egg' a thing of beauty and a joy for ever.

No doubt, the 'decorations' are, (to lapse once more into military phraseolgy), no more than an attempt at camouflage. It is difficult to believe that the bird's enemies are deceived by it. To human eyes, especially when the nesting site is so often in an exposed position, (for example, any bit of wire hanging under the eaves of a house, a low bush, the chicks on a verandah, overhead telephone wires), the nest seems to stand out so much from its surroundings that perfunctory attempts at camouflage would appear to serve no useful purpose.

One nest I observed was begun on January 17th, and was probably finished on the 1st February. By the 8th February two eggs had been laid, this being the normal clutch. As far as I am able to ascertain, a period of about 48 hours separates the laying of the first and a second egg. A note I have for 1950 shows that, in a nest containing 2 young, the first hatched on February 8th, and the second two days later. From this piece of evidence I base my conclusion that eggs are laid 2 days apart.

The period of incubation is some 14 days, and another 17 days later will see the young out of the nest[1]. A total of one month, therefore, sees the completion of the cycle of egg to fully-fledged young. Soon after, a second family is started, and after that a third, and even a fourth. The hen is kept very busy during the breeding season, and in that year when she attempted to raise four broods—the eggs of the fourth were abandoned—she looked a wreck by the end of the season, with unkempt feathers and a ragged tail. Together with her oriental sisters of the human race, she too, no doubt, could have done with a little family planning.

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[1] My notes for 1950 give the following data:—

27-1-1950: Two eggs in nest (first presumably laid on the 25th).
8-2-1950: First young hatched.
10-2-1950: Second young hatched.
23-2-1950: Nest accidentally disturbed by me. One juvenile flew out.
24-2-1950: Both juveniles left the nest.

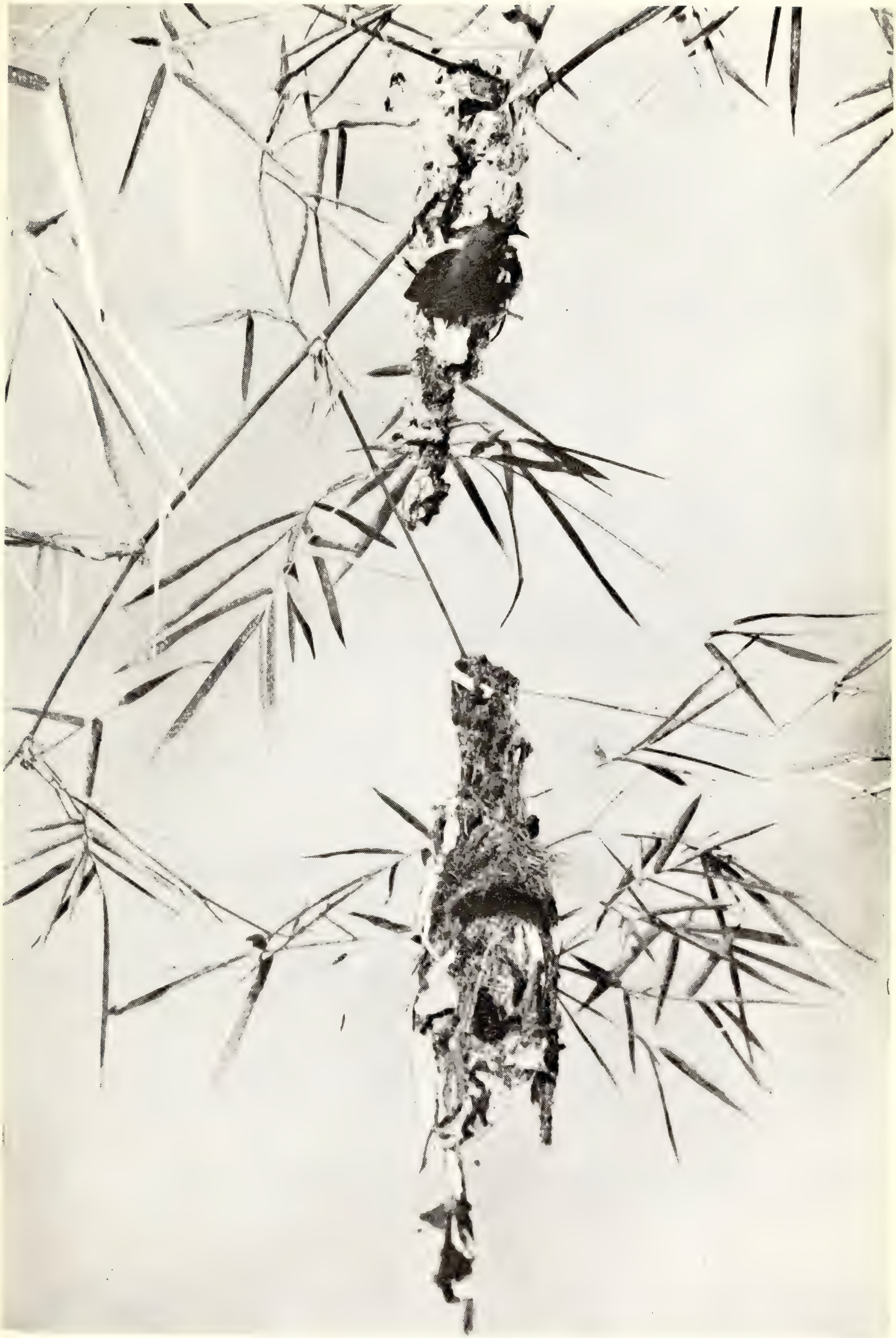


Photo *W. T. Loke*

Yellowbreasted Sunbird.

(*Leptocoma j. microleuca*).

Lower nest, partly completed, was abandoned when bird was frightened by flash. Another nest at once started above it.

When the young are being fed, the cock bird descends from his pinnacle of masculine detachment and helps his wife to keep the voracious hunger of his offspring satisfied. Even then, it is still she who does most of the work. Trips to the nest are frequent; on the 19th January 1950, I recorded 10 separate visits in the first hour, 13 in the second, and 12 in the third. It is not always easy to see the nature of the food brought, but on this day, the greater part consisted of a 'translucent white pill' which was probably the egg-case of some spider.

The parent birds are in such a great hurry to get on with the job of raising a second family, no sooner finished with the first, that the young of the first brood are given short shrift when they leave the nest. I once witnessed a poignant scene through that self-same bedroom window which has given me so many glimpses of the joys and sorrows of the Sunbird's world. At 7.20 one March morning, I heard excited bird voices coming from the bamboo clump. I hurried to the window and looked out. The excited chattering came from a fledging which was leaning out of its nest. Clearly, this was going to be a first flight, and the youngster was trying to pluck up courage to leave its home. The little bird leaned so far out that it nearly fell, but its courage failed at the last moment and it withdrew. Nothing daunted it tried again, and this time, with a supreme effort and one great convulsive movement, launched itself out into the world. The cock bird which had been standing close by and watching the proceedings with some interest, now suddenly took no more notice and began, in a detached manner, to preen his breast and wing feathers. The youngster flew straight to him, and sidling up began to beg for food. Then a strange thing happened. The cock without warning, dropped his pose of indifference and attacked his offspring viciously, making five or six quick jabs at the young bird, and nearly knocking it off its perch. The latter fell back before this unexpected attack and, for some time, sat crest-fallen and disconsolate, on another branch. Then the hen returned with food and flew straight to the nest. Finding it empty she looked around outside, and seeing junior, the very picture of dejection on his branch, flew to him and fed him. By this time, the cock had disappeared.

It is certain that the hen, before long, would, under the compulsion of a will greater than her own, have also adopted the same methods as the cock and driven her offspring away. And so, emerging into a pitiless world, the young Sunbird learned a lesson which all young animals learn, although in this case, sooner than most, namely the harsh truth of what the poet has called, 'the sorrow of each day's growing'.

A CONTRIBUTION TO THE ORNITHOLOGY OF THE DARJEELING AREA

BY

M. D. LISTER

This paper gives a short account of some of the birds of the Darjeeling area as they appeared to me during a series of bird-watching holidays spent on tea-gardens there in the years 1943-45. These holidays were of irregular occurrence as they consisted of either ordinary or sick leave from the R.A.F.; they usually lasted about a fortnight, except in 1945 when I stayed near Darjeeling for most of April, May and June. Details of these visits are as follows:—

1.	21 Feb.– 4 March 1943.	Pandam T. E.	Manager: W. Cooksey, Esq.
2.	18 –30 May 1943.	do.	do.
3.	17 –26 Jan. 1944.	Vah-Tukvar T. E.	Manager: the late Mr. E. H. Dobson.
4.	27 May –10 June 1944.	Soom T. E.	Manager: D. Smythe Osborne, Esq.
5.	21 Oct. – 1 Nov. 1944.	do.	
6.	17 April– 2 May 1945.	do.	Asst. Manager: W. Cooksey, Esq.
7.	24 May –30 June 1945.	do.	

My thanks are due to the Managers of these gardens and their assistants, in particular to Mr. and Mrs. Cooksey, for so generously welcoming me into their homes and for allowing me to wander about where I would.

The foothills of the Himalayas must surely possess one of the richest avifaunas in the world. It is certainly the most exciting bird-watching country I have found; you never know what you are going to see next and the possibilities are endless. At the same time the very diversity of the bird life creates an obstacle that is not easy for the casual visitor to overcome. No sooner has he become familiar with the birds most frequently met with during a day on the hillside than his visit is over, and by the time he returns he has lost much of what he had learned about the hill birds. And the very nature of the country makes accurate observation difficult, especially the study of particular problems. Definite identification is often impossible without shooting the bird in question and comparing its skin with specimens in a museum, in view of the bewildering variety of small birds to be found in the district, many of which look very similar to each other in the field. However, by dint of constant reference to all the books available to me, and visits to the Darjeeling Natural History Museum, where Mr. C. M. Inglis gave me unstinted help, I succeeded in identifying many of the birds I came across beyond any reasonable doubt. Where any doubt as to the identity exists in my mind I have made this clear in the appropriate place in these notes.

Apart from the three tea gardens on which I stayed, I visited very few others, and my notes are confined to these three alone. Although they were basically similar in that they consisted of blocks of Tea bushes [*Camellia thea* (Link)] of varying extent planted on land from which the original jungle had been cleared, and set in a matrix of mixed jungle on the steep hillsides, which were broken in many places by small jungle-clad ravines, these three gardens exhibited certain points of difference, of which the main ones are shown on the next page. The jungle was for the most part a widely varied mixture of deciduous trees and it was difficult to say just what species predominated. Utis (*Betula alnoides*) and Toon (*Cedrela toona*) were usually well represented, but there were many others and here and there were small patches of bamboos (? species). In some places *Cryptomerias* were growing in groves or clumps or as isolated trees. Undergrowth varied from barely any to a dense covering of bushes and brambles, with here and there a tree-fern, and luxuriant herbage sprang up during the rainy season.

The jungle and the tea blocks were so intermixed as to be almost inseparable as distinct habitats with any degree of accuracy, and most of the birds to be seen in the one could also be seen, at any rate at times, in the other. The chief shade trees interplanted among the tea were Sau or Black Siris (*Albizzia stipulata*) and Koroi or White Siris (*A. procera*). The principal *Leguminosae* interplanted were Indigofera (*I. dosua*), Boga Medeloa (*Tephrosia candida*) and in some places *Crotalaria*.

Although these three gardens ranged between about 1,800-6,500 ft. A.S.L., the preponderance of my observations were made between 3,000 ft. and 6,000 ft.

MOVEMENTS OF BIRDS

The rhythm of bird life in a district of high hills is inevitably more complicated than that of the plains, where there is no upward and downward movement. Darjeeling lies in a 'migration area' and can count in its avifauna a considerable number of winter and summer visitors as well as birds occurring only on migration.

In addition to this full-scale migration, however, the rhythm of bird life here is complicated by various more local movements and trends. I cannot pretend to have unravelled these complications during my few visits to the district, but it is just possible that some of my notes may help others in this task and I give them for what they are worth. Periodical visits do have the advantage that any gradual movement or change is often more apparent to the occasional visitor than to the man under whose eyes it has been taking place.

One of the most interesting features of bird life here is the mixed hunting parties of small birds. These were especially in evidence on my visits in January, February, March, April and October, though I found a few such parties on every visit. Some of these parties were only quite small, but some (e.g. October, 1944) must have comprised 200-300 small birds of numerous species. In April, 1944, the parties I saw were all smaller than those seen on the previous visit (January) and seemed to be more loosely knit. In some cases smaller parties broke off from the main party and moved off on their own; this was particularly the case with the Shortbilled Minivets, and I feel certain that often at this season the Greyheaded Flycatchers

POINTS OF COMPARISON BETWEEN THE THREE TEA GARDENS

	PANDAM T. E.	VAH-TUKVAR T. E.	SOOM T. E
Approx. acreage of:			
Tea ...	287 acres	500 acres	500 acres
Jungle ...	?	700 acres	1200 acres
Aspect: ...	E.N.E.	N.W.	N.W.
Altitude: ...	2,500 ft.—6,500 ft.	1,800 ft.—5,000 ft.	1,800 ft.—6,000 ft.
Shade trees: ...	Many, chiefly Siris	Few	Many, chiefly Siris
Leguminous plants used: ...	Fairly extensively	Extensively	Fairly extensively
Main jungle: ...	Below 4,000 ft.	Above 4,500 ft.	Above 4,500 ft.
Forestry methods: ...	Appeared not to be practised widely	Appeared not to be practised widely	Appeared to be practised thoroughly
Turfing of terraces practised: ...	Widely	Apparently little	Apparently little
Factory: ...	Small	Fairly large	Fairly large

foraged with the mixed party only because and while it happened to be passing through their particular territory.

In October, 1944, I identified the following species among these mixed hunting parties, and no doubt other species were also present:—

Greenbacked Tit
Indian Grey Tit
Redheaded Tit
Velvetfronted Nuthatch
Cinnamonbellied Nuthatch
Nepal Babbler
Redbilled Leiothrix
Redtailed Minla
Yellownaped Ixulus
Stripethroated Yuhina
Orangebellied Chloropsis
Whitetailed Blue Robin
Grayheaded Flycatcher
Whitethroated Fantail Flycatcher
Yellowbellied Flycatcher

Brownbacked Pied Shrike
Black Drongo
Grey Drongo
Haircrested Drongo
Yellowbacked Sunbird
Blackbreasted Yellowbacked Sunbird
White-eye
Speckled Piculet
Darjeeling Pygmy Woodpecker
Large Yellownaped Woodpecker
Lesser Yellownaped Woodpecker
Lesser Pied Woodpecker

Numerous Willow and Flycatcher Warblers, most of which I could not identify with any certainty.

In April, 1945, I identified only the following among mixed hunting parties:—

Greenbacked Tit
Redheaded Tit
Redbilled Leiothrix
Redtailed Minla
Yellownaped Ixulus

Browneared Bulbul
Silvereared Mesia
Greyheaded Flycatcher
White-eye
Shortbilled Minivet

A fair number of Willow and Flycatcher Warblers.

That there is a good deal of seasonal movement up and down the hillside is, of course, well known. A frequent comment in Messrs. W. H. Matthews' and V. S. Edwards' 'List of Birds of Darjeeling and Neighbourhood' (1944) is 'Lower in winter'. I doubt, however, whether the extent and details of this vertical movement have been fully worked out yet, or whether the controlling factors are fully understood. The effect of the weather on the food supply is probably the governing factor, but there may well be other factors, e.g. the earliness or lateness of the Monsoon, the amount of rain, the relative amounts of sunshine and cloud, which exercise some accelerating or retarding influence on the movement.

No doubt the dispersal in all directions of fledged young birds, which has been found to take place with some species in Europe, also plays its part in complicating still further the existing complexity of all these movements. I myself saw some evidence of an *upward* movement in October above the usual limits given by Matthews and Edwards (see Sultan Tit and Haircrested Drongo). This is a point which invites further study.

Another point which might be studied with profit is the effect on bird life of the relative amounts of sunshine and shade due to the configuration of the hillsides. Some slopes are so placed that they obtain the maximum available amount of sunlight, while others are in sunshine for only limited periods each day. Whether the seasonal variation in the amount of sunlight falling on a given hillside, which can be very marked, causes any change in the incidence of bird life there is a question which would be very difficult to answer with complete certainty, as any such movement would clearly be very gradual and would probably be overshadowed by the other major seasonal movements. My own observations were not extensive or continuous enough to cover these points.

A factor which may well have some small effect on the bird population of a tea garden is the forestry methods practised there. Purely local changes of population may also be caused by the practice of hard-pruning the tea bushes every fourth year or so, thus destroying a good deal of cover until new growth has again got well started. I believe only certain blocks of tea are treated in this way each year, and that on each garden these are well scattered.

Messrs. Matthews' and Edwards' 'List of Birds of Darjeeling and Neighbourhood' gives the general status of nearly all the birds occurring there and is a great help to a visiting bird watcher. The authors admit, however, that the list is probably not completely exhaustive and in 1945, not much more than a year after its publication, Mr. Edwards himself told me that no less than seven further species had been identified in Darjeeling itself. I hope, therefore, that the following notes, which I believe to be accurate as far as they go, may add something to the stock of knowledge being accumulated about the birds of Sikkim, and that they may perhaps be of some help to others in the work of interpreting the rhythm of bird life on these fascinating hillsides.

For the sake of brevity I have referred in the following pages to Pandam T.E. as 'A'; to Vah-Tukvar T.E. as 'B'; and to Scom T.E. as 'C'.

In making my own records of bird sounds I used the method devised by W. Rowan (1924), but as this entails the use of various symbols which are difficult and expensive to print, I have used another, and rather less accurate, method in the following notes.

Jungle Crow (*Corvus macrorhynchos*)

Status: A few usually about on all three gardens, in the shade trees almost as much as in the jungle. No seasonal variation in status noticed.

House Crow (*Corvus splendens*)

Status: I saw none on A or B, but there were usually a few to be seen on C about buildings, in the forest, and in the shade trees.

Yellowbilled Blue Magpie (*Urocissa flavirostris*)

Status: I saw them only irregularly on all three gardens in January (a party of 7-8), February, May and October (1-2 each), in both jungle and shade trees.

Voice: 28-2-1943. A rather hollow-sounding k-k-k-ok-ok-ok the bird rising and stretching upwards on its perch and then bowing slightly. Tail frequently flirted with a little upward jerk, but most of the time it was merely waved indefinitely about. This bird flew away with a heavy, though quite powerful flight, giving a loud, rather mellow ko-we-wak (low-high-low) as it went.

Green Magpie (*Cissa chinensis*)

Status: Not seen on A or B; 1-2 seen and heard on C in April, June and October, all in jungle.

Voice: 6-6-1944. One called several times with a kik-wee (high-falling). The more usual call seemed to be a rather raucous mewing note. 29-4-1945. One gave a loud, penetrating, and rather tinny courlye-tya (high, rising-low) several times.

Tree Pie (*Dendrocitta formosæ*)

Status: Seen on A and C only, mostly in jungle but not infrequently in shade trees. Usually there were only a few about, but they seemed more numerous on my visits in May and June, when they were often in small parties.

Voice: 28-2-1943. A frequent wokuwak'awk with strong emphasis on the penultimate note. This was followed by some higher, fairly rounded, chattering notes of which I was unable to make any record.

22-10-1943. One was working through fairly dense tree jungle, calling at fairly frequent intervals, each time with the same call: kak'l-ik'l-aa-kaa (low-high-low-low).

25-4-1945. The calls heard included the following: k-k-k-k-t-t-kok (high-low, slurred); kawelu-ja (low/high, slurred-low) repeated several times; kik'kala'ka-loi-u (falling/ris-ing-low) with variations.

Grey Tit (*Parus major*)

Status: In October, 1944, I am quite convinced that I saw on Soom T.E. at least one, and I believe 2-3 others, of this species, with which I was very familiar from the plains of Bengal. Unfortunately I did not at the time realise the unusualness of their presence in this district and did not take down a full description, or even an exact note of the height. In spite of an urgent exhortation later on to borrow a gun and go out there and then to shoot one, I was unable to produce a corpse, and I am afraid, therefore, that if the old maxim 'What's shot is history, what's missed is mystery' is still accepted as the guiding principle, my record will not be admitted, though I know my identification to have been correct.

Greenbacked Tit (*Parus monticolus*)

Status: Seemed fairly plentiful on all three gardens, though I saw fewer on my autumn and winter visits than in the spring and summer. I quite often found them foraging among the tea bushes and shade trees.

Redheaded Tit (*Aegithaliscus concinnus*)

Status: A few parties seen on all three gardens at all seasons, always in jungle. I could detect no real change in status.

Recognition: Continually on the move, picking about among the leaves high up in the trees, or perhaps among dense bushes on the side of a ravine, hanging upside down and clinging sideways to the twigs, though often remaining still for a second or two. When one flew to another clump of bushes the others would follow in a straggling crowd, the movement, although one of only a few yards, taking perhaps a minute to complete.

Voice: Various dates: A soft trr-trr-trr or tz-tz-tz, difficult to describe phonetically, was given continually. Another party called almost continuously with little, almost bell-like notes while they foraged. Also a very frequent, soft, rustling prrri-prrri.

Sultan Tit (*Melanochlora sultanea*)

Status: A single bird seen 30 October, 1944, near a mixed party of tits and other small birds (mostly warblers) about some *Boga Medeloa* bushes among tea at 4,500 ft. Later seen following a mixed party of Shortbilled Minivets and Pied Shrikes with several Drongos in mixed deciduous jungle with thick undergrowth, also at 4,500 ft.

Recognition: The first time I sighted it the sun was almost directly behind it, so that details of its colouration were not discernible, and it struck me in silhouette as being rather like a small Oriole. Later I got good views. This bird flew to a clump of bushes where it clung upside down near the top of a spray, apparently extracting seeds or insects, and also climbing about. Once it caught a large winged insect—probably a grasshopper of which thousands were then present.

Voice: Now and again it would give a soft, high-pitched tyu. I also heard a single phrase of fairly rounded, though rather strident notes, which I think was given by this bird; but of this I could not be absolutely certain.

Cinnamonbellied Nuthatch (*Sitta castanea cinnamoventris*)

Status: One seen on A and two on B, while on C in October some were present among nearly every mixed hunting party. Seen only in jungle, with one possible in tea and shade trees on C. I saw none on C in April, May or June.

Voice: 25-2-1943. One gave a quiet ti-ti-ti continually while foraging, also a fairly loud, prolonged tsip. I also heard a much louder, more raucous note given in alarm on discovering my presence.

Behaviour: 25-2-1943. One worked over a large siris tree, starting near the bottom of the main trunk and working upwards, spiralling irregularly and sometimes stopping and turning completely round so that its head was downwards while it explored some crevice. It worked over the main branches more or less systematically and then gave its attention to the thinner branches towards the top of the tree, where it seemed equally at home. Sometimes it worked downwards as well as upwards, and often hammered vigorously. Flight bounding.

Velvetfronted Nuthatch (*Sitta frontalis*)

Status: One party reported by a competent observer on C in June, and I saw one in October 1944, both in jungle. I saw no others for certain.

Rufousnecked Laughing Thrush (*Dryonastes ruficollis*)

Status: Fairly plentiful on all visits on each garden except B (January) where I saw none. I found them equally among the tea bushes and the edges of (though never far inside) the jungle near the tea. On C in June 1944 I found that they often emerged from the tea to the edge of the jungle towards dusk, possibly for roosting purposes.

Recognition: They spend most of their time among and under the tea bushes and undergrowth, but often they will flutter up into a larger bush and stand flirting their tails, which seem cumbersome and disproportionately large and floppy, gradually hopping further and further up towards the top of the bush and then flying down among the lower bushes again. They frequently indulge in what seems to be calling and answering each other, and I have heard as many as four birds join in, though they may all be invisible to the watcher. Flight rather heavy and ungainly.

Voice: 24-5-1943. 2-3 were foraging together among tea. One flew up into a small siris tree and sang. The song was varied, but one or two phrases formed the basis of the theme, upon which many apparently impromptu variations were grafted. The general effect was quite pleasing, though perhaps a little uninteresting, and not to be compared with the song of, say, a Whistling Thrush, which it in no way resembled, being altogether much fuller in tone, more broken and the whole *timbre* different. Specimens of the basic phrases were as follows:—

Pouki-wurki-pouki-wurki (rising in 'steps')

Prrurti-witeu-witeu (the second syllable of the first note being high, and the two last notes falling).

Witeu-sprutsita-pretuu (the last syllable of each note being pitched lower than the penultimate one).

These notes and their variations, with a fair number of extraneous notes and groups of notes, were often combined into phrases of fair length; but the effect was rather detracted from by the interpolation of single notes, much in the same manner as a Common Myna sings.

Among other calls I have at various times recorded these:—

(1) A loud prui-prui.

(2) Chre-chre-che-chui-chi starting high and falling.

(3) A clear, loud, pwe-tyu—se-pwe-tyu—se-pwe-tyu—se-pwe the first syllable of each note being higher than the others.

(4) A clear, loud, ringing peuklu-peuklu (high/low) rather like a staccato version of the word 'bugler'.

(5) A loud, powerful kwik-kokoiu (high-low/high/low) repeated several times as a phrase, and sometimes broken when bits of it were given separately.

(6) One would call with a loud, clear kyu-wa-kyi (high-low-high) and another would at once answer with the same call. Then a third bird joined in and answered each call with a sharp kyi.

Greysided Laughing Thrush (*Dryonastes cœrulatus*)

Status: Two believed seen in jungle on C on 19-4-1945 at 4,500 ft., but I caught no more than a glimpse.

Blackgorgetted Laughing Thrush (*Garrulax pectoralis*)

Status: 2-3 believed seen among tea on A on 20-5-1943 (altitude not noted), but I was too far away for certainty. The general colouring was: head and chest black; remainder dark brown with a touch of yellowish in the wings. They were very noisy and called continually with a variety of notes, of which the predominant ones were s'prepa-prepra-prepa . . . s'pre . . . wou-wou . . . wou-pi—sik (the first syllable of all the double notes being high and the second lower, and the last note being low-high—high).

Necklaced Laughing Thrush (*Garrulax moniliger*)

Status: Several believed seen on C on 6-6-1944 in thick jungle with tall trees close to the Little Rangit River (approximately 2,000 ft.). Flight very awkward and the birds glided a good part of the way from one tree to another with outstretched wings and tail. Once in a tree, however, their movements were much surer and less cumbersome and they turned actively this way and that, flirting their big tails and calling (no record of call). Identity almost but not quite certain. Crown and nape rufous yellow; forehead and sides of head medium grey; throat and neck white, bordered with a fairly broad blackish necklace; rest of upper parts grey-brown; rest of lower parts pale grey-white.

Whitethroated Laughing Thrush (*Garrulax albogularis*)

Status: Believed seen on all three gardens in both tea and jungle. One believed seen on C at 5,000 ft. on 27-5-1945. The only certain identification was on A on 28-2-1943 (altitude not noted).

Voice: 28-2-1943. Wauk-waakawa (high—low/high/low).

Redheaded Laughing Thrush (*Trochalopteron erythrocephalum*)

Status: Seen in small numbers on all three gardens in February, April, May and June in both tea and jungle.

Voice: One of the most striking and insistent calls I heard was a loud towit . . . towit (low/high . . . low/high), sometimes given separately, sometimes several times running, less often mixed in among other calls.

Another call was a liquid pwi or poui (all one syllable), and a harsh, not very loud che-che-che-che-che all on the same note.

Another bird called repeatedly with a loud preuri (falling/rising and slurred), often repeated more than once.

Crimsonwinged Laughing Thrush (*Trochalopteron phoeniceum*)

Status: One believed seen in tea on 17-4-1945 and two in jungle at 4,500 ft. on 26-5-1945, both on C.

Striated Laughing Thrush (*Grammatoptila striata*)

Status: Believed not infrequently seen in jungle and one probable one in tea in May, 1943 on A. I saw no recognisable sign of this species on my other visits.

Rusty-cheeked Scimitar Babbler (*Pomatorhinus erythrogenys*)

Status: Identified with certainty only on C in June 1945, in jungle at 4,500 ft., but strongly suspected on C in October, 1944 and April 1945. I think I probably overlooked this species on other visits, through never having seen it, and I suspect that it was better represented than its occasional appearances in public seemed to suggest.

Voice: The only note I managed to record was a fairly loud qrrp.

Spotted Babbler (*Pellorneum ruficeps*)

Status: Several seen in tea with other babblers (not identified) on A on 25-2-1943. Altitude not noted.

Blackthroated Babbler (*Stachyris nigriceps*)

Status: In tea: One seen on C at 4,500 ft. on 20-4-1945. In jungle: 3-4 on A on 28-2-1943. 3 or more on C in June 1945.

Voice: 28-2-1943. An explosive chhrrri, repeated several times when my presence was discovered.

20-4-1945. A repeated, loud, insistent tweeye-t'twa (rising—low) with very little variation.

Redheaded Babbler (*Stachyridopsis ruficeps*)

Status: 1-2 parties seen in jungle on A in February, 1943.

Voice: Called continually with a single, high, thin note.

Yellowbreasted Babbler (*Mixornis gularis*)

Status: A party of 12-20 believed seen on A on 26-2-1943. Upper parts a nondescript brown; wings and tail blackish; lower parts lemon yellow, brighter on abdomen. They worked along under the tea bushes. As I approached, some of them flew over the tops of the bushes, perching for a few seconds on a protruding stump of wood *en route*. All the time I was near they kept up a quiet, rustling calling, rather like shr-shr-shr, but impossible to describe exactly. Exact altitude not noted, but I believe it was about 3,000-3,500 ft.

White-eyed Quaker Babbler (*Alcippe nepalensis*)

Status: I saw this species only on C, always in jungle or secondary bush growth. On 9-6-1944 at 4,800 ft. I found a family of parents and several fledged young ones. In May-June, 1945 I saw several birds. On 26-10-1944 I found several in a mixed hunting party of small birds in dense bushes in a ravine at 4,500 ft.

Behaviour and Voice: 9-6-1944. My attention was first drawn to the birds by a sudden movement in the undergrowth only a few feet away, followed by a low, rustling, whispering calling. Then suddenly the whole party of parents and youngsters flew past me to the bushes at the other side of the path. The parents were very perturbed and darted hither and thither among the undergrowth; they kept very well under cover themselves, though I could often catch clear glimpses of them, when the white ring round the eye was conspicuous. One of the young birds perched on an exposed branch and gave a quiet dzi-dzi, which provoked a fresh outburst of activity and calling on the part of the other birds. Their calls consisted chiefly of a rapid, high-pitched dzi-dzi-dzi-dzi-dzi, and a very soft, whispered, high-pitched pi-pi-pi-pi-pi-pi-pi-pi-pi.

Blackheaded Sibia (*Leioptila capistrata*)

Status: Seemed fairly plentiful on all visits, though in April 1945 there did not seem so many on C (2,000-6,000 ft.) as higher up about Darjeeling itself. In January, 1944, I found them only just above the Little Rangit River among tea bushes, but otherwise I saw them only in jungle. In January they often seemed to be in company with Yellownaped Ixulus.

Voice: The only calls I have identified from this species are:—

(1) A harsh, rasping chrai-chrai-chrai-chrai-chrai, the *a* being pitched low, the *i* high.

(2) A very soft, low-pitched tyip . . . tyip . . . tyip or tsi . . . tsi, scarcely audible 15 yds. away.

Stripethroated Yuhina (*Yuhina gularis*)

Status: 1-2 seen in jungle on A in May, and a few seen in jungle, usually in mixed parties, on C in October.

Slatyheaded Yuhina (*Yuhina occipitalis*)

Status: 30-5-1945. Soom T.E. A party of half a dozen or so small birds was foraging among herbage and bush undergrowth growing among dense mixed jungle at 4,500 ft. My attention was first attracted to them by a low, soft, rustling calling which seemed to be coming from the herbage almost at my feet. This was confirmed by a slight movement, but the birds were adepts at keeping under cover, though several times they came up and perched on exposed branches where I got a good view of their upper parts. Size: about the same, or possibly slightly smaller than a Redbilled Leiothrix (*Leiothrix lutea*). Forehead and crown greyish brown, fairly heavily streaked bluish-white; streaks ill-defined, but the general effect was that they ran from front to back. Nape plain, warm brown. A narrow white half-ring round upper half of eye was conspicuous; I could see no sign of the lower half of this ring, but this might have been due to a trick of the light. Rest of upper parts warm brown. Lower parts (I had little more than a glimpse) seemed fairly bright orange brown. Tail short, broad, square, warm brown. Bill horny brown. Legs yellow-brown.

Yellownaped Ixulus (*Ixulus flavicollis*)

Status: At least one party seen in tea bushes just above the Little Rangit River on B in January 1943; otherwise seen only in jungle. Some seen on every visit except the first, but they seemed more numerous in October and January, when some were with almost every mixed hunting party I found.

Recognition: Movements rather more leisurely than many small birds, though their examination of the foliage seemed very thorough. The orange collar round the hinder neck and the brown crest are usually easily seen.

Voice: Various dates.

(1) A soft high-pitched tyuk . . . tyuk, the *k* being slurred.

(2) A soft tyityi-tyuk (high/high-low, slurred).

(3) Tyup-tyup . . . tyu (high-high . . . low, slurred).

(4) One party kept up a continual *pizzicato* twittering which rose, when one section of the party detached itself and flew to another clump of bushes, into a much louder, raucous note.

(5) On 26-10-1944 several birds of this species were with a large mixed hunting party. While these birds were present a loud song was continually given. I never managed to see any bird in the act of singing, but this song seemed so frequently to emanate from just about the same spot as these birds were foraging that I very strongly suspect it was given by them. The basis of the song was a: Twe-tyurwi-tyawi-tyawa (high-low/high-low/high fall-ing/low). This basis was frequently varied, but its general character could always be recognised in the variations.

Redbilled Leiothrix (*Leiothrix lutea*)

Status: Seen in tea only on first visit, otherwise only in jungle. Noted as plentiful on all visits except in January, when I saw none. In October some were with almost every mixed hunting party.

Recognition: The orange breast and the red and yellow in the wings are usually conspicuous.

Voice: Various dates. Song: A full and rounded warbling, not unlike that of the Garden Warbler [*Sylvia borin* (Bodd.)]. Wings frequently flirted while singing.

Other notes:—

(1) A continual and unvaried pe-pe-pe-pä (high-ris-ing-lower), clear and fairly loud, but rather wistful and piping. On another occasion I recorded this note as a pü-pü-pü-pü-pü, all on the same note, clear and piping and given rapidly.

(2) A continual, soft muttering che-che-che, fairly high-pitched.

(3) A loud, rustling call of which I made no phonetic record.

(4) When disturbed, a somewhat explosive k'd'k-chá-jöjü (the last note higher than the second), followed by a call sounding something like pile-pile-pile, each 'word' consisting of the same two notes the second of which was pitched higher than the first.

Redtailed Minla (*Minla ignotincta*)

Status: Noted as fairly plentiful on every visit, very often in mixed parties. Fewer seen in May and June. Seen only in jungle.

Behaviour: Their behaviour varied, possibly according to whether my presence was known or not. At times they would hop about and perch quite openly on the upper parts of the bushes. At other times they would dash helter-skelter for the deeper cover of the centres and lower parts of the bushes, where they would creep about, giving a low murmuring note. I saw one bird ascend a sloping branch in a series of small hops and sidling movements.

Voice: Various dates.

(1) A continuous, rather scolding calling, fairly varied, but of which the burden was choi-choi-choi-chu-chi-choi-choi-chu-choi-chi-chi-chu (the first three notes low, the fourth and fifth rising, the sixth and seventh low, the eighth high, the ninth low, the tenth high, then falling).

(2) A rather sharp, high-pitched wi-wi-wi while flying from one bush to another.

(3) A loud chik (slurred and high-pitched) repeated 7-8 times.

(4) A fairly loud twiyi-twiyuwi (high-high/low/high).

(5) A ringing se-tyewi-tyewu-tyewu (high-high/falling-higher/low).

(6) A very rapid p'tyityityi pitched high.

(7) A frequent, high-pitched tsi . . . tsi.

(8) A rapid chattering, high-pitched chitititititititit.

(9) A loud, shrill, very tit-like whi-whi—te-sik-sik (low-low—high-low-low).

(10) A loud, clear tye-tye-a-tyü.

Nepal Cutia (*Cutia nipalensis*)

Status: 29-4-1945. Soom T.E. Two believed seen flying between trees in a large ravine at 4,500 ft., though I had only a glimpse of them. In general appearance, seen from above, they were not unlike shrikes. Head black on sides, slaty-blue on crown. Back seemed entirely chestnut. Tail black, not so long as in many birds of a similar size. Wings slaty-blue, black and white. Lower parts appeared whitish, but I did not get a good view. Size roughly the same, or perhaps a little smaller than a Blackheaded shrike (*Lanius nigriceps*).

Redwinged Shrike-Babbler (*Pteruthius erythropterus*)

Status: Seen only on C in jungle, where I found several pairs in April, and noted them in May and June as fairly plentiful.

Recognition: Rather clumsily built; movements often somewhat ungainly and jerky. Always on the move, exploring leaves and crevices for food, hopping and clambering about among the twigs, now and again flying with hurried, weak wing-beats to a new perch. The shortness of the tail was very striking.

Voice: 27, 29-4-1945. A low, liquid pik . . . puk was given when two were foraging together.

A single ♂ kept giving a variety of calls as it foraged, some soft, but mostly fairly loud. My attention was first attracted by what appeared to be the song, as it was repeated frequently and loudly and had fair carrying power: Pu-sitsiteu (low-high/high/low) . . . pu-sitsiteu (low-high/high/low) . . . pu-sitsiteu-sitsiteu (low-high/high/low-high/high/low) . . . su-teutu (low-high/falling).

The most characteristic and frequently used phrase was the first, but now and again the double version was given. This combination was occasionally varied by giving the last phrase on its own, repeated rather rapidly several times. Now and again the song was interspersed with a low chrrri . . . chrrri.

Orangebellied Chloropsis (*Chloropsis hardwickii*)

Status: I found this species only on C, as follows:—

June 1944, one believed seen in jungle at 5,000 ft. October 1944, several seen in jungle. April 1945, one seen once in shade trees among tea. May and June 1945, seen occasionally in shade trees, but always 1-2 in evidence about same place in jungle, 4,500 ft.

Voice: October 1944 and May 1945. The song was varied and included many notes which could easily be mistaken for those of other birds, including the Bulbuls, Drongos and Tits, and the usual call of the Crested Serpent Eagle, if one did not see the singer. I was unable to distinguish any particular phrase or combination of notes which always formed part of every song, but the following were among those I recorded:—

(1) Tshiwatshishi—watshishi—watshishi (high/low/high/high—low/high/high—low/high/high), with many rambling variations.

(2) A soft tit-like titu-titu-titu-titu-ti the first note in each pair being pitched high, the second low.

(3) A low tp-tp-tp-tp-tp-tp-tp.

(4) A loud, rapid ti-ti-tsyi, the latter note repeated 7 times and followed by a prolonged hoarse, scolding note.

(5) Pitu-pitya-pitya (high/low-rising-lower/high) repeated twice and followed by pitu (falling).

(6) Tyawit-tyatyawi (repeated 3 times)—tya (low/high-low/high/high-low).

(7) Tsitsawaitsei-tsawaitsei (twice) (falling/low/rising—low/rising).

(8) Siu-siu-pse-sitsitse-psi-psi-seu-siui-siu-siu-psiui (high-high-higher-low/low/high—high-high-falling—rising in middle—lower-low-rising in middle).

On one occasion so many different notes were given that I thought a mixed hunting party of small birds was present, but no other birds appeared.

Silver-eared Mesia (*Mesia argentauris*)

Status: Only one seen, on 23-4-1945, on C, in a small mixed hunting party in secondary jungle growth at 3,500-4,000 ft.

Black Bulbul (*Microscelis psaroides*)

Status: Plentiful on A and C, but I saw none on B in January, and only a few on C in October. Plentiful in April, rather fewer in May, and towards the end of June there were several small parties about, which I think contained young birds. Seen mostly in tree jungle, but I found them foraging freely among shade trees among the tea in April, May and June.

Voice: Generally rather noisy. Notes harsher and less varied than those of the Striated Green Bulbul. The 'song' seemed to consist of a long series of mostly monosyllables of varying tone and pitch, punctuated at frequent intervals by a single, high conspicuous, rather bell-like note. I also heard a fairly loud, rapid wurkiyu (rising/low) repeated several times at fairly short intervals.

Behaviour: At any rate in the breeding season they were inclined to be very aggressive, and I saw them attack and drive off a Large Hawk Cuckoo, and on another occasion a Whistling Thrush. In one case a pair of Bulbuls followed the Cuckoo into a tree and perched only a foot or so away from it. They made frequent pecking attacks on it and I saw some pale breast feathers dislodged, the Cuckoo flinching, turning to face its attackers, fanning out its tail and raising its wings.

Brown-eared Bulbul (*Microscelis flavala*)

Status: Seen only once, on 20-4-1945 on C, in fairly dense mixed tree jungle at 4,500 ft., among a mixed hunting party of small birds.

Rufousbellied Bulbul (*Microscelis macclellandi*)

Status: One seen once for certain, on 25-4-1945 on C, in trees in fairly open mixed forest at 4,800 ft. 1-2 believed seen on C in May and June 1945.

Recognition: General colour brown, tinged green on the back, wings and tail. A lighter-coloured stripe on each side of the neck. A short, rough crest, not very conspicuous. Flight rapid and powerful.

Voice: My attention was attracted by its loud, clear, rather sharp calls, usually a double tsyi-tsyi, pitched high and sometimes given three times. This call was repeated numerous times in succession, at first with very little variation, but later with a good deal.

Striated Green Bulbul (*Alcurus striatus*)

Status: A few seen on all visits, but only in May and June 1945 did I find them at all plentiful. I saw them only very occasionally in tea or shade trees as they kept almost entirely to tree jungle, where they usually seemed to keep to the upper branches.

Voice: Various dates. A party would often keep up a continuous series of full, clear, pleasant warbling notes, rather disjointed but even so of the warbling type. One or other of them was almost always singing or calling. The only specific calls I recorded were:—

(1) Tyiwut (high/low, slurred), rather sharp and given continually.

(2) A loud pyik . . . pyik (high and slurred) given several times and followed after a pause by several more of the same notes, merged with a rapid string of variations thereon.

Redvented Bulbul (*Molpastes cafer*)

Status: Plentiful on all three gardens, where they foraged in the tea, the shade trees and leguminous shade plants, and less often in the jungle. In January (B, 1944) they were well represented in one or two mixed parties of Bulbuls and there were also a few by themselves. In February (A, 1943) I found them mostly in pairs, though there were still several flocks. In April (C, 1945), and May (A, 1943 and C, 1945) they were mostly in pairs, and in June (C, 1944 and 1945) the position was the same, though there were signs of family parties beginning to form. In October (C, 1944) I found them mostly tending to be in flocks.

Voice: As none of my notes refers to birds in the Darjeeling area I have not included them here.

Behaviour: 24-5-1943. A pair was clinging to the main trunk of a Siris tree, probing into the patches of green lichen growing there. Normally I saw them only on the less vertical twigs and branches.

27-5-1943. A pair mobbed a Tree Pie.

Whitecheeked Bulbul (*Molpastes leucogenys*)

Status: The annual cycle appeared to be similar to that of the Red-vented Bulbuls (q.v.), though I think this species was on the whole a little less plentiful. In May 1943, on A, I noted a tendency to keep towards the edge of the tea blocks where the jungle undergrowth gave additional cover.

Voice: 25-2-1943. A party of about 30 was feeding among tea bushes; one gave a soft, creaking kyä-yä-yä, pitched low. My other notes do not refer to Darjeeling birds.

Behaviour: 26-2-1943. A Black-headed Shrike flew onto a branch on which two Bulbuls were perched, and about 2 ft. from them.

At the time they were standing about 18 in. apart, but on its arrival they hopped close together and stood facing it and scolding hard. They did not actually mob or attack it, as I have seen them do to a Black Drongo, and as soon as it flew away they took no further notice.

26-10-1944. Several were foraging among the tea bushes. They repeatedly made steep sorties into the air, apparently after insects, returning just as steeply to the bushes, or else to a neighbouring tree from which the next flight was made. In these flights the white tips to the tail feathers showed up conspicuously as a black and white check pattern.

Brown Dipper (*Cinclus palasii*)

25-5-1943, A. A single bird seen, well down the valley, which I think was probably a young one.

Blue Chat (*Larvivora brunnea*)

Status: January 1944, B. A single ♂ seen among fairly dense bushes and brambles at the edge of a small ravine, on 23rd January. My attention was first attracted by a soft robin-like tt-tt-tt and after several minutes the bird came up on to an upper spray of the bush in full view, and then dived back under cover with a somewhat louder call of alarm. The following day a ♂ suddenly flew down the hillside at tremendous speed, making a real whizzing sound and passing close to my head before diving into the cover of dense bushes. I saw it again a few seconds later, but after that the only indication of its presence was the rather soft tt-tt-tt. I believe this species was well represented there at that time, though more often heard than seen.

26-10-1944, C. A ♂ perched in a tree in mixed jungle above dense undergrowth at 4,500 ft. The tail was flirted and the bird gave a soft tit . . . tit now and again. Later I saw what I believe was a ♀ in almost the same place.

Whitebrowed Shortwing (*Heteroxenicus cruralis*)

Status: June, 1945, C. The identity of the birds in question was never established beyond every possible doubt. At one time I thought they must be Red-flanked Bush Robins, but later, after a better view and a visit to the Darjeeling Natural History Museum, I came to the conclusion that they were of this species. I therefore give these notes for what they are worth. I found several birds of the same species scattered over this garden, but I do not remember seeing them on any other visits or either of the other gardens.

The ♂ was entirely deep indigo blue, though I believe more blue-grey on the underparts, and in some lights the blue of the fore-crown looked lighter and brighter. A suspicion of a black mark near the eye. I could never decide whether or not there was a faint white eye-stripe. The general colour of the ♀ was tawny olive-brown, rather greyer on the head. Most of my views were from above, among fairly dense bushes where the light was poor.

Voice: I heard these calls:—

(1) A rather thin, *very* highly-pitched 'song' of two notes, the second one pitched about a quarter-tone lower than the first. Always to be heard at frequent intervals.

(2) A broken succession of very soft, very high-pitched notes in no recognisable pattern, just a broken, inconsequential rambling seei (rising) . . . sree . . . sree-ee (rising).

(3) A very Robin-like tt-tt-tt-t-t-t-t.

Behaviour: They usually kept either among the heads of saplings (Utis, etc.) and bamboos, or among low bushes, or on the ground itself, and were difficult to watch satisfactorily. I found them at various places on the Soom T.E., usually between about 4,000 ft. and 5,500 ft. In some ways their movements were very like those of a flycatcher. The bird would make short sorties from its perch, apparently after passing insects, returning either to the same or another perch and waiting, singing at intervals. Although they might remain in much the same spot for minutes on end, the particular pair I was watching would keep moving about through the jungle over an area of perhaps two acres, where the song could always be heard.

Indian Stonechat (*Saxicola torquata*)

Status: Curiously enough I saw only one of these birds on all my visits, on 24-1-1944 on B, among tea and leguminous shade plants.

Dark Gray Bush Chat (*Rhodophila ferrea*)

Status: I found them to be rather thinly, though fairly evenly distributed over all three gardens. In January 1944, I found a few at the edge of the jungle, but otherwise they were always in the tea.

Voice: (1) Various dates. A rasping prrei (rising).

(2) 28-5-1943. The basis of the song was a wisachisawisaseu (high/low/high/low/rising/low) with variations. The basis of a song of another bird, which was given very quietly and not at all obtrusively, was slightly different: swetiswetiwtrrwe (rising . . ./low/high). The first two groups of syllables were pitched the same, i.e. the first two syllables were practically repeated.

(3) 23-1-1944. A fairly sharp tak-tak-tak-tak.

(4) 22-4-1945. One gave a short song, typically chat-like in character, but perhaps rather sweeter than most, and with fewer wheezing, grating notes than the songs of most of the chats with which I am familiar.

Spotted Forktail (*Enicurus maculatus*)

Status: 1-2 seen on each garden.

Voice: The only notes I heard were a loud, rasping jeer and a harsh, grating krrreeet.

Little Forktail (*Microcichla scouleri*)

Status: One reported on Pandam T.E., February 1943, though I saw none myself.

Bluefronted Redstart (*Phoenicurus frontalis*)

Status: In February and March 1943 on A I found both sexes plentiful throughout the tea and cultivated terraces, sometimes both seen together, sometimes alone. In January 1944 on B, I found only a few, well scattered over the blocks, slightly more plentiful than the Black Redstarts.

Voice: 25-2-1943. The first intimation of their presence was usually the soft call tt-tt-tt-tt-tt, which sounds rather like a noisy watch being wound up a few cogs at a time (less than a complete turn of the winding knob). This call is given in flight as well as from a perch.

One bird gave a low, warbling song, much less wheezy than that of a Black Redstart, and quite quiet—almost inaudible ten yards away.

Black Redstart (*Phoenicurus ochrurus*)

Status: In January 1944, on B, I found a few, well scattered in both tea and jungle. In April 1945 on C at least one was regularly to be seen about a block of tea with shade trees at 4,500 ft., but I have no record of it after 25th April.

Whitecapped Redstart (*Chaimarrhornis leucocephalus*)

Status: One seen near bottom of valley on A on 28-2-1943, about stream in ravine. In January 1944 I found them fairly numerous about the Little Rangit River below B.

Voice: 28-2-1943. The call was a loud, clear, penetrating seei . . . seei (rising), which was clearly audible above the sound of the waterfall. I believe the bird also gave a throbbing yibib:bibibibib, but as I did not have it actually in sight at the time this call was given I cannot be absolutely certain.

Behaviour: Tail flirted in the usual Redstart manner. When perching on the boulders in the stream they often flew into the air, with quick twists and turns, presumably after insects.

Plumbeous Redstart (*Rhyacornis fuliginosa*)

Status: One believed seen on 26-5-1943 on A in jungle. In January 1944 I found them slightly more numerous than the Whitecapped Redstarts about the Little Rangit River about B.

Voice: 18-1-1944. One sang while perched on a boulder only a few inches above the swirling water of the river. The noise of the water prevented my hearing all the notes, and all I could tell was that the song lasted for perhaps 7-8 seconds, and that most of the notes were fairly strident.

Behaviour: They often flew into the air, flycatcher fashion, from the boulders on which they were perching, presumably after insects. Tail frequently fanned and flirted, when the chestnut colour was conspicuous.

Whitetailed Blue Robin (*Muscisylvia leucura*)

Status: I became familiar with this species only on C, where I first saw one among bamboos at 4,500 ft. on 31-10-1944. In April, May and June 1945, I found them fairly plentiful, though rather thinly distributed from about 4,000 ft. upwards, and the song was to be heard from many of the ravines and patches of jungle.

Voice: 20-4-1945. The song was clear and sweet, with a definite Robin-like flavour about it, and consisted of several phrases each given separately with varying, but considerable, pauses between. The only phrases I was able to record were a te-tle-i-ta—we-i (high-lower, slurred-high-low—rising-high), and a flowing tl'yei-ya-wei (high-higher-low-high—rising). The first of these two phrases was given a good deal more frequently than any of the others.

Behaviour: 20-4-1945. The bird would perch on a twig while singing and lean forwards, at the same time spreading the tail; but curiously enough the white in the tail was hardly ever visible when it did this, though it was conspicuous in flight.

2-5-1945. One which was singing continually raised and depressed its tail quite slowly and at the same time expanded and contracted it. From my position on the path above it the narrow white lozenges in the tail were very conspicuous.

Magpie Robin (*Copsychus saularis*)

Status: I saw none on B, and only a few on A (February, March and May) and C (all visits), where I found them both in tea and jungle.

Behaviour: 27-5-1943. One was attacked and driven away by a Blackheaded Shrike and a Grey Drongo, which flew at it simultaneously.

Whitecollared Blackbird (*Turdus merula albocinctus*)

Status: One believed seen on B in jungle at 4,000 ft. on 25-1-1944.

Greywinged Blackbird (*Turdus boulboul*)

Status: There seems to be a good deal of seasonal movement in this species. In January on B I saw none. In February on A, I saw only one, though I believe a few others were present. In April on C I found only a few. In May 1944 on C I saw only 1-2, though in May and June 1945 on C I found them plentiful. In October on C, again, I found only a few. Sometimes they foraged in the tea and shade trees, but for the most part they kept to the jungle. Some were no doubt overlooked on those visits when they were not in full song.

Voice: Various dates. The song consists of one soft note introducing four high-pitched notes on a descending scale, which at various times I recorded as pee-pee-pee-pä (German ä), si-tse-te-eye-tyu, and cha-tee-tee-tee-tee.

The introductory note is very soft, but the four main notes have considerable carrying power. Heard from a distance they are pure and fluting, but from a few yards away they have a slight edge to them, almost a vibration, as though it were the note and its echo heard together. They can be heard at all hours of the day in May and June (? also in other months). The fall between the first three of the four main notes is very slight, scarcely more than half-tones, while the drop between the last two is rather greater.

One bird I watched gave a low warbling subsong immediately after the ordinary loud song, lasting only a few seconds, with a slight pause in the middle. In quality it was not unlike the subsong of a European Blackbird (*Turdus merula*), but less rounded and finished, and rather flatter and more insipid. This bird then flew away giving a true Blackbird chuckle as it went.

Redthroated Thrush (*Turdus ruficollis*)

Status: One believed seen in shade trees 24-2-1943 and another on 1-3-1943 on A, but identity not proved.

Blackthroated Thrush (*Turdus atrogularis*)

Status: Several seen on C in October 1944, mostly ♀s, though at least one ♂, usually foraging on main estate road where it ran through thin mixed jungle at about 4,500-5,000 ft.

Plainbacked Mountain Thrush (*Oreocincla mollissima*)

Status: One believed seen 25-10-1944 on C, foraging on the main estate road where it ran through thin mixed jungle at 5,000 ft. Comparison with specimens in the Darjeeling Museum suggested that the bird was of this species, but identity not proved beyond all doubt.

Lesser Brown Thrush (*Zoothera marginata*)

Status: One possibly seen on A on 23-5-1943 in both shade trees and jungle, but identity not proved.

Chestnutbellied Rock Thrush (*Monticola rufiventris*)

Status: One seen twice in tea and shade trees on A in February 1943. In October 1944 on C I found several, including a ♂ and ♀ seen together several times, in both tea and jungle, though not often in the ravines.

Blueheaded Rock Thrush (*Monticola cinclorhyncha*)

Status: I saw none on A or B, but on C I found them fairly plentiful, though rather thinly distributed, in jungle only, in April, May and June, mostly in pairs.

Voice: 29-5-1945. The song had a recognisable thrush-like quality about it, though the notes were not very clear-cut. It sounded roughly as follows, though the lack of definition, or rather the slight slurring of the notes, made it difficult to make an exact phonetic record:—

Tra-trree-trrea-tre-prua-tritri-prua-tri and so on (low-high-high/lower-high-low/high-higher-low/high-higher). This was the basis on to which were grafted variations.

Between bursts of the 'normal' loud song, the bird also gave several other much softer notes, though they were still just audible some 50-60 yds. away. As far as I could tell these were exactly similar to the ordinary loud notes, but they were much softer and were not flung out with such abandon for all the world to hear. They were not quiet enough, however, to be considered as Whispering Song or Subsong.

Behaviour: A bird, perched in a tree, wagged its tail slowly and deliberately up and down.

Blue Rock Thrush (*Monticola solitaria*)

Status: Matthews and Edwards (*op. cit.*) give this species as a not uncommon winter visitor and say nothing about its occurrence in this district in summer. On 9-6-1944 I found a single bird at 4,500 ft. on Soom T.E., about some creepers and herbage growing on a small cliff some 50 ft. high. I have no doubts at all as to the identity of this bird.

Whistling Thrush (*Myiophoneus coeruleus*)

Status: Plentiful on all three gardens on all visits, though less in evidence on C in April, May and June 1945. Not infrequently seen in the tea blocks and shade trees, though they kept more to the hillside jungle and ravines.

Voice: (1) 15-2-1943. A usual note was a loud, rather rasping chrei (rising), given both when in flight and when perching.

(2) 26-2-1943. The song (at dawn) was a very sweet, rather thin, reedy whistle, which followed a definite pattern with slight variations. The notes could have been set to music by anyone with a musical training, as the majority corresponded to the notes on a piano.

(3) 22-10-1944. As one bird chased another through a patch of bamboos, one, or possibly both, gave a peculiar low spluttering noise, something like the noise that is produced by pressing the lips to the back of the hand and blowing, but more sustained and quite impossible to render phonetically.

(4) The usual call, [as in (1) above] can also be described as ty'rree . . . ty'rree (rising), the *y* not being pronounced as a vowel.

(5) I also heard the subsong. [See Lister (1953)].

Maroonbacked Accentor (*Prunella immaculata*)

Status: One believed seen among fairly dense bramble-type bushes and herbage in mixed jungle at 4,000 ft. on B on 20-1-1944, but identity not proved beyond all doubt.

Sooty Flycatcher (*Hemichelidon sibirica*)

Status: A few seen on A and C in February and October. In May and June I found a few on C at about 5,000 ft. and over.

Voice: 31-5-1944. Song: A very high-pitched, thin, reedy little song, usually of three notes tsee-see-see in descending-scale in half or quarter tones or even less, with occasional variations. Not unlike a thin edition of the song of a Greywinged Blackbird.

Ferruginous Flycatcher (*Hemichelidon ferruginea*)

Status: One believed seen in mixed jungle (? about 5,500 ft.) on A on 24-2-1943, but identity not proved.

Redbreasted Flycatcher (*Siphia parva*)

Status: One, possibly two, seen in mixed jungle in April 1945 on C, but I saw no others.

Little Pied Flycatcher (*Muscicapula melanoleuca*)

Status: In May and June I saw at least two in a mixed hunting party on A, among a dense patch of tall trees in a small deep ravine at 5,000 ft.; and on C 2-3 in a mixed hunting party at 5,000 ft. Possibly these were unmated birds. In October on C I found a 'family' of 7-8 in a large mixed hunting party at 4,500 ft. in jungle.

Voice: 26-10-1944. One bird, foraging with a party of 8-10 others, gave some very soft warbling notes interspersed fairly frequently by equally quiet grating notes. It was so quiet that I could only just hear it 10 yds. away, without being able to distinguish its exact pattern or phraseology.

Behaviour: They kept for the most part among the heads of the trees and seemed to get most of their food inside the trees themselves, rather than from outside the canopies. The birds I watched spent most of their time making little fluttering flights from one branch to another and made few sorties outside the canopy of the tree. They also took some of their food from the crevices of the bark and from the leaves. The flight was easy but less agile than that of many flycatchers.

Verditer Flycatcher (*Eumyias thallassina*)

Status: In January on B I saw none; in February on A I saw only two; in April, May and June on A and C they were numerous, while in October on C I saw only a few again. They often foraged from the shade trees among the tea, though I think there was a tendency to keep more to the jungle. They seemed on the whole to prefer the rather more open parts, but I several times found them in quite thick jungle. I do not remember ever seeing any of this species with the mixed hunting parties of small birds.

Voice: (1) 28-2-1943. One repeatedly gave a tze-ju-jui (high—falling—low/high).

(2) 20-5-1943. A song given frequently at intervals of several minutes, sometimes in groups of 2-3 repetitions, was a pe-tititi-wu-pititi-weu (low—high—lower—rising/falling—low).

(3) 26-5-1943. One gave a very soft, high-pitched p'p'pwe . . . p'p'pwe . . . p'p'pwe before giving the usual trundling little song. On more than one occasion the ordinary song reminded me strongly of that of the European Hedge Sparrow (*Prunella modularis*).

Behaviour: (1) 18-5-1944. One caught a fairly large brown moth or butterfly on the wing and retired to a perch to eat it.

(2) 25-5-1945. One kept flying to the lichen-covered face of a large vertical rock and clinging there, turning this way and that for a minute or so, and then returning to a perch on a nearby creeper. Whether this action was connected with nesting or foraging I could not tell.

Tickell's Blue Flycatcher (*Muscicapula tickelliae*)

I give this record for what it is worth.

8-6-1944. Soom T.E. A flycatcher of medium size (about 6-7 in.) was in a grove of bamboos and deciduous trees growing on the steep hillside at about 4,000 ft. I had it under observation for only a few minutes, but during that time I had several good views. This bird sang continually with a song very like a sharper, shorter and more staccato song of the European Robin (*Erithacus rubecula*). One of the phrases, the only one I managed to note down was tsea-sea-si-e-e-e-e (high/low-high/low-higher-very high).

Upper parts dark blue, tinged greyish. Chest, throat and chin orange. Rest of lower parts white. The bird was very sprightly in its movements and kept flying up from its perch to catch insects in the usual flycatcher manner.

I puzzled a lot over the identity of this bird and eventually reached the tentative conclusion that it must have been of this species. The Largebilled Blue Flycatcher (*Muscicapula magnirostris*) is stated in the F.B.I. to be 'essentially a bird of evergreen, humid forests'. The absence of blue on the throat and chest seems to rule out the Bluethroated Flycatcher (*M. rubeculoides*), the White-eyebrowed Blue Flycatcher (*M. superciliaris*) and the Sapphireheaded Blue Flycatcher (*M. sapphira*). The white of the abdomen, etc. seems to rule out the Rustybreasted Blue Flycatcher (*M. hodgsoni*), and this same feature and also the size suggests that it was not a Rufuousbreasted Blue Flycatcher (*M. hyperythra*). I was not familiar with any of these species and a visit to the Darjeeling Museum did not enable me to clinch the matter.

Greyheaded Flycatcher (*Culicicapa ceylonensis*)

Status: Fairly plentiful on all three gardens on all visits, especially on C in April, May and June. Usually among mixed hunting parties in February and October. Fewest seen in January on B. Mostly in jungle, especially the steeper parts and ravines, but I saw a few in tea.

Voice: (1) 26-5-1943. A quiet chichictrrr (high) with variations.

(2) 29-5-1943. A not very loud pu-pi-pi-pi-pui (low-rising-rising-rising-high).

(3) 23-1-1944. A very frequent call, clear and almost ringing, was a kitwik . . . kitwik (high/low . . . high/low). One also gave a series of longer three-syllabled notes kui-whi-whi (rising-low-low).

(4) 8-6-1944. The 'song' consisted of variations on a theme of se-tyissi-a—tyissi-a-tyi (high-high-low—high-low-high).

(5) 17-4-1945. Several in a mixed hunting party gave a tyi-ti-wi-tyi (low-high-low-high), and now and then a tye-ta-wi (low, slurred-lower-high).

(6) 25-4-1945. One foraging alone; the only note I heard was a very soft pit . . . pit . . . pit, high-pitched and the consonants indistinct.

(7) 29-4-1945. 'I have at last managed definitely to track down the song, which is loud and can be heard almost everywhere just now. It sounds like a tee-tata-tei (high-low-rising) or pee-satatei (high-low-rising), the consonant sounds being indistinct. There

is a second phrase, too, that is often given: p'sita-i (high/low-high). Dewar's rendering of the song as "Think-of-me" I found sometimes recognisable.' And see below.

Behaviour: 29-4-1945. 'I found two birds engaged in a performance, which I think must clearly have been the courtship, above a large ravine at 4,500 ft. This ravine is more open than most just here, and has one or two small rocky precipices flanking it. Elsewhere its face is covered with a dense secondary growth of bushes and brambles and a small stream rushes down its centre. The chief performer I assume to have been the ♂ and will call "A", though I had no means of definitely identifying its sex. Its companion I assume to have been a ♀ and will call "B".

'A kept flying without ceasing for nearly ten minutes, going round and round in a rough circle of some 30 yds. diameter. B would perch on a twig on the face of one of the small cliffs and A would deliberately fly just in front of her and then turn and fly out over the ravine. As soon as he was over the middle of the ravine he would hover for a moment on rapidly vibrating wings, dropping perhaps a few feet. B would then fly straight at him and miss him by only a few inches. She would then fly back to a perch on the cliff and he would circle and again fly just in front of her, when the whole performance was repeated.

'B usually left her perch almost immediately after A had passed her, though now and again she waited until he was actually hovering before she left it; and once or twice she missed her cue completely and did not leave her perch at all until A came round again, having hovered for a second or two unavailingly over the ravine. The whole performance must have been repeated at least 15-20 times while I was there, and I cannot tell how many times before I arrived.

'When A was hovering the grey of his head and the pure bright yellow-green of his rump were very conspicuous. His flight was surprisingly swift and he would often shoot off at a tangent to his previous line of flight. Their wing-beats were very rapid, almost flickering, and A at times almost seemed to dance in the air. Throughout the whole performance both birds called continuously with both the phrases mentioned in paragraph (7) above. I believe, but cannot be certain beyond all doubt, that the longer phrase was given almost entirely by A, while the shorter phrase was given almost exclusively by B.

'Eventually B remained on her perch and A settled on a small bush growing on the side of the ravine and began making short foraging sorties, still calling persistently with the longer of the two phrases.'

Large Sikkim Niltava (*Niltava grandis*)

One believed seen among bushes in mixed jungle on A in May 1943, but identity not proved.

Rufousbellied Niltava (*Niltava sundara*)

Status: I saw 1-2 in May and June on A and C, but no others for certain.

Voice: 23-5-1943. (1) A note sounding like a rather soft cha . . . cha, low-pitched and insistent.

(2) A soft pea . . . pea (high/low . . . high/low).

Behaviour: A ♂ made no attempt to catch passing insects, but simply stood quietly on the stump of a dead bough for some minutes, bobbing the body forwards and its tail up every few seconds.

Small Niltava (*Niltava magrigoriae*)

Status: Two seen on C on 17-4-1945 in mixed jungle.

Voice: The only note I heard was a very high-pitched, thin see-see, the second note being pitched about a quarter tone lower than the first.

Yellowbellied Flycatcher (*Chelidorhynx hypoxanthum*)

Status: I saw this bird only during the winter—two or more in January on B, and in October on C some were in almost every mixed hunting party. In both cases I saw them only in jungle.

Whitethroated Fantail Flycatcher (*Leucocerca albicollis*)

Status: I saw only very few on A in February and May and on C in October (all in jungle), and none on B. On 27 February two were among a large mixed hunting party.

Voice: 23-1-1944. One while foraging gave a fairly soft dji . . . dji.

Behaviour: 27-2-1943. They would flutter up to a branch, usually close to the main trunk, and posture and bow and turn this way and that, continually fanning and closing the tail, and to a lesser extent flirting it. Now and then they would make a sortie away from the tree, but they never went very far. The tail was often fanned in flight. Often they would move rapidly out along one of the main branches. The flight from one tree to another was fairly direct and slightly dipping. They would 'swing' over a lateral branch almost as though vaulting it, and sometimes they hung upside down. They worked down the main trunk as often as (or even more often than) up it. In any direction progress was never direct, but consisted of a series of rapid, jerky twists and turns. I have several times seen one apparently turn head over heels, and at others appear to throw itself sideways or backwards. I have also seen one working over the bank of a ravine, which was well covered with a tangle of roots, ferns and other plants.

23-1-1944. A bird kept to a great extent to the tops and outsides of the bushes, almost tumbling about them as it turned this way and that, continually fanning its tail.

Blackheaded Shrike (*Lanius nigriceps*)

Status: There seemed to be a fair seasonal fluctuation in numbers. In January 1944, on B only a few were seen, all in tea. February 1943, A, numerous, most singly but a few in pairs. April 1945, C, fairly plentiful, though rather thinly distributed. May 1943, A, seemed slightly less numerous than on this garden in February; a nest with one egg in a small sapling among tea at about 3,500 ft. on 20th May; a single fledged young one seen on 27th May. May 1944, C, a few seen, but they did not appear to be so numerous as on A in May, and much less so than on A in February. May 1945, C, fairly plentiful, though rather thinly distributed. June 1945, C, fairly plentiful, though rather thinly distributed. October 1944, C, only 1-2 seen. In May 1943 and 1945 I found a number in jungle, though the majority kept to the more open ground under tea; apart from this I saw them only in the tea blocks.

Voice: 27-2-1943. One perched on top of a low tree and sang. It started with the usual rasping tjö . . . tjö . . . tjö and gradually this call become shorter and more explosive in quality and the intervals between got shorter. Then came a whole variety of notes, harsh in quality at first but becoming sweeter and fuller as the song progressed. Some of them were repeated 3-4 times in phrases and the general effect was very similar to an inferior and more varied song of the European Song Thrush (*Turdus ericetorum*). This singing was kept up with no appreciable pause for at least five minutes, when it died down and was continued spasmodically with a greater proportion of harsh notes for another 2-3 minutes. The song was surprisingly good for a shrike.

27-5-1943. A (?) young bird was perched on an exposed branch, continually flapping (rather than shivering) its wings and giving a soft harsh jä-jä-jä (rising) at frequent intervals.

Behaviour: 24-5-1943. One attacked and drove off a Black Drongo by flying straight at it, without actually striking it.

25-5-1943. One attacked and drove off a Maroon Oriole out of a small tree by flying rapidly at it.

Greybacked Shrike (*Lanius schach*)

Status: January 1944, on B, one among tea at 4,500-5,000 ft. On 29 May 1943 (A) among bushes in mixed jungle at 6,200 ft. I saw a shrike which I can only think was of this species, though I had it in view for only a minute. On 20-4-1944, (C) I had good views of one in a Boga Medeloa bush among tea and heard it singing (altitude not noted), while I have a further note of seeing 'one or two' in tea during May and June 1945 on C, though no other details.

Voice: 20-4-1945. The song was fairly soft and consisted of a sustained rambling, a mixture of warbling and twittering notes. Its quality was fairly good, many of the notes being well rounded and quite mellow, but it did not strike me as being nearly so fine a song as that of the Blackheaded Shrike. I did not hear it imitate the calls of any other birds.

Behaviour: 19-1-1944. One caught a small moth or butterfly, which it held in its beak for several minutes before eating.

Brownbacked Pied Shrike (*Hemipus picatus*)

Status: I found this species only on C in April, when at least one party was with other small birds, and in May and June on C when I saw a single bird; and on 30-10-1944 a party of 7-8 on C.

Voice: 30-10-1944. A party of 7-8, foraging, kept up an almost continuous calling, sometimes with a tsit-it-it-it-it-it (pitched high), and sometimes with a call sounding more like the one mentioned by Whistler (1941) as whi-ri-ri—whi-ri-ri—whi-ri-ri.

17-6-1945. One gave a sharp, high-pitched sisisisisisi or tsisisisisisisi.

Behaviour: 30-10-1944. A party of 7-8 was foraging in company with some Shortbilled Minivets in mixed deciduous jungle and its bush and bramble undergrowth. Their behaviour was more suggestive of a flycatcher than a shrike, as they perched in all parts of the bushes and lower trees, and made short sorties into the air after passing insects. They did not remain long on any one perch, but kept moving from one place to another.

Nepal Wood Shrike (*Tephrodornis gularis*)

Status: I saw one only, on 26-10-1944 on C, in mixed trees growing among tea bushes.

Behaviour: It moved slowly along the branches of the trees, working along them in a series of rather clumsy hops. Its whole bearing was somewhat furtive. Its progress from tree to tree was slow, and it spent some time apparently examining the twigs and branches for food.

Scarlet Minivet (*Pericrocotus flammeus*)

Status: Matthews and Edwards (*op. cit.*) give this species as common, but on all my visits I found it much less plentiful than the Shortbilled Minivets. In May 1943, on A, I saw at least one pair, and at the end of May 1945 on C a single ♂ was about for a few days and then disappeared.

Shortbilled Minivet (*Pericrocotus brevirostris*)

Status: I found this species much more plentiful than the Scarlet Minivet on all my visits. They were to be seen in the shade trees among the tea as much as in the jungle.

Voice: 26-2-1943. Several pairs together . . . the first intimation of their presence was invariable the shrill 'song' tiwiwiwi, (low/high/high/high) which was given persistently by both sexes. One I watched kept giving a really churring shrrrri (high) . . . shrrrei (high-rising) . . . twi-wi-wi (high-high-low) . . . shrrrrei (high-rising) . . . twi-wi-wi (high-high-low) all mixed up together.

24-5-1943. A ♀ on her own was, until I approached, continually giving a loud shi-chiwit-chiwit-chewau (high-rising-rising-lower/low).

25-5-1943. Two ♂s were flying round in company. At least one kept giving a twee-twi-twi—switiswee (high-low-low/rising—rising/high) with variations, as they flew. A little later one ♂ was alone at the top of a bush and two of the ♀s flew to the same bush. At the same time the ♂ started singing a more complicated song (too involved and too rapid for me to be able to record phonetically). The basis was a fairly loud switi (pitched fairly high) with many variations, and often run together to form phrases.

27-5-1943. A ♂ and ♀ were together among trees. Both gave a soft wi . . . wi, pitched fairly high.

21-1-1944. A party of 2-3 ♂s and 4-5 ♀s . . . kept calling with a fairly high-pitched se-sei while foraging. When they flew to another group of trees with the typical, rather hesitating flight, they gave a series of calls, rather like a se-wa-wa-wui—se-wa-wa-wui (each phrase high-low-low-rising) with several modifications and variations.

30-10-1944. The basis of the calls given was a whi-whi-whi-si-wee (high-high-low-high-lower).

Dark Grey Cuckoo Shrike (*Lalage melaschista*)

Status: Plentiful on both A and C in April and May, though I saw fewer in evidence in June.

Voice: 9-6-1944. One gave a song consisting of four notes in descending-scale, which I heard often on this visit.

Behaviour: The text-books all say that the Cuckoo Shrikes never descend to the ground, but on at least one occasion I saw birds hopping about on the ground among tea bushes. For the most part they kept well up in the trees, though I have also seen them working rather surreptitiously through rough undergrowth under trees.

Ashy Swallow Shrike (*Artamus fuscus*)

Status: Fairly plentiful on A and C in April, May and June, and 1-2 still left in October. A pair with fledged young found in May on A; they seemed to have an extensive territory, covering several hundred yards of the hillside.

Field Recognition: Flight very swallow- or martin-like, with something of a Starling's flight in it, continually turning this way and that in a long glide on extended wings, interspersed with short periods of rapid, flickering wing-beats. Tail fairly large and square. Wings tapered sharply on both edges. When seen in flight from above the white on the rump is conspicuous. When perched, they frequently turn the head from side to side.

Voice: 18-5-1943. A rather harsh vit . . . vit.

19-5-1943. The song was introduced by several of the usual rather harsh notes jupjupjupjup-jiji (pitched low, the *j* being soft as in the French 'je'), followed by a series of trilling, warbling notes. The bursts of song were never very long, lasting perhaps 10 seconds; nor were the pauses in between very long, either. The bird frequently turned about on its perch and its tail was continually wagged up and down.

17-4-1945. Several were hawking for insects high above the hillside, calling continually. The calls were somewhat ill-defined and difficult to record phonetically, but as far as I was able to record them they were as follows: wrik-wrik-wrik-wrik-wrik (high-pitched) . . . wrä—wrä (low) . . . wrikik—wrä (high—low) with variations.

Behaviour: 19-5-1943. One caught what looked like a large dragonfly and carried it to an upper branch of a tree, where it dismembered it, holding it down on the branch with its feet and pulling the wings off with its beak—a process which lasted some two minutes. It then carried the remains to another tree where a youngster was shivering its wings, but I did not see it feed it.

20-5-1943. A bird with fledged young in the vicinity made a diving attack on a Great Himalayan Barbet, which was presuming to 'sing' in a neighbouring tree. The attack failed to dislodge the Barbet and the Shrike then desisted. But when the Barbet flew off down the valley in a steep glide, the Shrike followed at really tremendous speed in a kind of 'power dive' for at least 100 ft. and pulled out when only a foot or so above the Barbet.

24-5-1943. One dived down on a Maroon Oriole, pulling out of the dive when only a few feet above its head, and driving it out of the tree.

27-5-1943. Two attacked a Jungle Crow at the same time as a pair of Grey Drongos were attacking it. The Shrikes' attack consisted of shallow dives, while those of the Drongos were very much steeper and more spectacular. After a few minutes the Crow flew off and after a parting dive the Drongos desisted, but the Shrikes continued to harass the Crow until it was at least 50 yds. away.

Later a Great Himalayan Barbet was perching in a tree. I saw it look upwards and it apparently caught sight of a Swallow Shrike gliding some 40 ft. above, for it at once dived away down the hillside, obviously scared, though the Shrike took no notice of it.

All these records relate to the same pair of Swallow Shrikes, which had fledged young ones not far off.

Black Drongo (*Dicrurus macrocercus*)

Status: As suggested by Matthews and Edwards (*op. cit.*), the status of this species deserves further study. I found some unaccountable fluctuations and I will therefore give a summary of my detailed notes:—

January (1944, B): A few seen in both shade trees and jungle.

February (1943, A): None noted.

April (1945, C): A few only seen in jungle.

May (1943, A): Fairly numerous in both shade trees and jungle.

May (1944, C): A few in shade trees and jungle (but fewer than Bronzed Drongos).

May (1945, C): A few believed seen in jungle, but identity not certain.

June (1944, C): A few in both shade trees and jungle.

June (1945, C): A few believed seen, but identity not beyond doubt.

October (1944, C): Numerous in jungle and more open ravines.

This was easily the least well represented of the four Drongos I saw.

Voice: 30-10-1944. Two, chasing each other, gave a querulous wee-wee-e—wee (high-higher—high), and a wewiwiwiwiwi (low/h-i-g-h), while flying.

Grey Drongo (*Dicrurus leucophaeus*)

Status: Although this species seemed to me to be much better represented than the Black Drongo, I did not usually find it very numerous.

January (1943, B): A few—I think slightly more than Black Drongos.

February (1943, A): A few seen, some in pairs.
April (1945, C): Plentiful.
May (1943, A): Rather more numerous than Blacks.
May (1944, C): A few—many fewer than the Bronzed Drongos.
May (1945, C): Plentiful.
June (1944, C): A few—many fewer than Bronzed Drongos.
June (1945, C): Plentiful.
October (1944, C): Only a few believed seen, but none certainly.

They were to be seen both in the forest (especially the more open parts) and also the shade trees among the tea, and in May 1943, I have a note that they seemed to prefer the latter.

Voice: 20-5-1943. One was singing from the upper branches of a large Siris tree. It was the usual type of song with a large number of cheeki notes in it, but there was a large proportion of pure notes, some of them so sweet as to be almost fluting, yet powerful. Tail frequently moved about while singing.

27-5-1943. The song was far better, more complicated and more finished than the usual song of the Black Drongo. It started with a loud, rather grating, metallic se-tuk-tyuk (high-low-high) repeated several times and then went on after a pause into a much more complicated, rambling song, including a kotukakekea (high/low/high/low) with variations. At times the notes were given so closely after one another that the song assumed the nature of a rough warbling. It was all very loud and rather ringing in quality.

28-5-1943. One gave a very good and varied song from a tree. It began with a loud, rapid call switswitswitswit (pitched high) not unlike one of the calls of a Tailor Bird. Then after a pause it began to sing. The song was far more varied and of a better, fuller quality than the usual song of a Black Drongo. Some of the phrases were repeated 2-3 times, while others were more warbling, and others again were rather sharp, short and grating.

21-1-1944. 4-5 foraging together gave a wipwipipip-yurjiu (high-low/high, falling).

Field Recognition: They gave me the impression of being even more agile on the wing than the Black Drongo. In flight the grey of the chest is fairly conspicuous against a dark background, and they seem to me to have rather more gloss on the back than the Black Drongo, but this may be illusory.

Behaviour: 27-5-1943. See under Ashy Swallow Shrike.

Bronzed Drongo (*Chaptia aenea*)

Status: When present this seemed to me to be by far the most umerous of the four Drongos I saw.

January (1944, B): None seen.
February (1943, A): None identified, but presence suspected.
April (1945, C): Plentiful.
May (1943, A): A few seen.
May (1944, C): Very numerous.
May (1945, C): Fairly plentiful.

June (1944, C): Very numerous.
June (1945, C): Fairly plentiful.
October (1944, C): Numerous.

I found them equally in the forest and in the shade trees among the tea.

Voice: 21-10-1944. 3-4 together, singing. The song seemed to me to contain a higher proportion of throaty noises than the songs of the other Drongos with which I was acquainted, combined with other high-pitched chirruping notes.

30-10-1944. 3-4 together, singing loudly and persistently between their foraging sorties. Among other notes, one particular bird gave the following:—

Tp-chiwik-chiwik-chiwik (low-high/low-high/low-high/low) . . . kyipkyipkyipkyipkyip (high) . . . kyawip-ip-i—chirra—kyirra—kyirra (low/h-i-g-h—low/high—low/high—low/high) . . . kya—tzit-tzit—kyirra-kyirra (low—high-high, slurred—high/low-high/low). All the notes were staccato and almost all were very clear-cut. At a distance the song sounded not unlike a poorly-finished song of a European Song Thrush (*Turdus ericetorum*).

Behaviour: 4-6-1944. One flew to a deciduous tree growing on the edge of mixed jungle and tea at about 4,500 ft. It perched there for a few minutes and then flew down and clung upside down to a small spray of leaves, apparently searching for insects. It remained like that for perhaps five seconds, then let go with its feet and clung for a split second with its beak only, and then flew up to perch again in the normal way. Throughout the performance the wings were fluttered for balance.

30-10-1944. 3-4 were in company with 1-2 Black (?) Drongos and 3-4 Haircrested Drongos. All of them spent a good deal of time, in the intervals between foraging and singing, in chasing each other. This they did freely and I think playfully.

Haircrested Drongo (*Chibia hottentotta*)

Status: I identified this species only in May 1943 on A, when they were numerous—rather more so than the Bronzed, though fewer than the Grey Drongos, in both shade trees and jungle; in May 1944 (C) when I found only about one pair; and in October 1944 on C when they were fairly numerous in the jungle (though not much in the ravines), usually in company with other birds and I found 2-3 parties in which this seemed to be the predominant species. Matthews and Edwards say that this species breeds up to 4,000 ft. and is seen lower in winter, but most of my October observations were made between 4,000 ft. and 5,000 ft., so it would appear that these birds had come up the hill. Seen in company with a party of Longtailed Broadbills, and also Shortbilled Minivets and other small birds.

Field Recognition: They are masters of aerobatics, but their heavier build makes them seem rather less agile than most of the other members of the Drongo family that I met. You can nearly always hear their thudding wing-beats.

Voice: 27-5-1943. The usual call was a very clear weeeee-tyik (rising-low) the first note long drawn out and rising, and the emphasis on the second, lower note. Sometimes a syllable ya (low) was added a good deal more softly than the other notes. Occasionally a single tyuuuuuu (rising) was given by itself.

One bird gave a fairly typical Drongo note, though in some indefinable way it was rather different, and the usual cheeki type of note did not enter into it at all.

23-10-1944. About a dozen were foraging in mixed tree jungle in company with about the same number of Long-tailed Broadbills. They called very frequently with a varied assortment of notes, all loud and powerful, some harsher than the calls of other Drongos, others fairly sweet. Once or twice when they were chasing each other I heard a low-pitched, almost grunting call, which was not made by the wings.

30-10-1944. 3-4 in company with some Bronzed Drongos. In the intervals of foraging they perched in the branches of the trees and sang. One bird, which I was watching in particular gave among others the following notes: zör-si (low-high) . . . zör-swi-swi-zaza-sue-sya (low-high-high-low/low-high, rising-low). The z was rounded like the soft French j in 'je'. These notes were followed by a loud, rather clear-cut rambling warbling, not unlike the everyday song of the Common Myna, and this was followed by tsye-tyse-tsye—wewei—tsyi-tsyi—we—wai (high-high-high—lower/rising—high-high—high—low/rising).

Behaviour: 6-6-1944. One chased a Tree Pie, diving at it very fast and then sheering off and shrieking at it, while the Tree Pie dived for cover into the leafy part of a tree.

Tailor Bird (*Orthotomus sutorius*)

Status: Seemed plentiful on all three gardens on all my visits. In October they were often in twos and threes. I found them both in the jungle and in the tea bushes, though they showed a definite preference for the latter in April, May and June.

Voice: 24-1-1944. 3-4 foraging together called continually with a titaweet (high/low/high), usually repeated several times with no appreciable pause between. A little later they gave another loud clear call tyeea (high/low). One particular bird gave this call in quick succession with barely any pause between. The number of repetitions throughout a period of about two minutes was 19, 4, 8, 7, 8, 3, 5, 5, 3, 5, 3.

Let me here confess that most of the numerous small warblers, which occur so often among the mixed hunting parties and on their own, quite defeated me. I had left my Zeiss glasses at home and had only a rather inferior pair of non-prismatic glasses with me, which did not make identification of these difficult little birds any easier. I managed to identify only a very few of the Willow and Flycatcher Warblers I saw with certainty.

Greyheaded Flycatcher Warbler (*Seicercus xanthoschistos*)

Status: I saw none in January on B, but otherwise they seemed fairly plentiful. Seen among mixed hunting parties in February and

October. They were not shy, though very active, and fluttered about the branches, sometimes perching only a few yards from me.

Chestnutheaded Flycatcher Warbler (*Seicercus castaniceps*)

Status: I saw only one to identify positively, on 22-10-1944 on C among a large mixed party of small birds at 5,000 ft.

Strongfooted Warbler (*Homochlamys fortipes*)

Status: I found none in January or October, but this may merely have been due to their silence, as they are more often heard than seen. On A I found them fairly plentiful in both tea and bush jungle in May, and also in February (though I did not identify them until later). On C they seemed to be more thinly distributed in April (when I heard only one, in bush jungle, and saw none), May and June from about 4,700 ft. upwards. This bird is very difficult to watch as it keeps out of sight among the tea bushes and undergrowth, but with the assistance of Mr. Inglis, of the Darjeeling Museum, and later of Mr. V. S. Edwards, then of Darjeeling, I succeeded in identifying it beyond any doubt.

Voice: 1-3-1943. The call was given persistently every minute or so for some minutes, and was answered by another. It was a loud and penetrating, clear though thin tyüü—tweet-weu (rising, prolonged—high-falling), the tyüü being an invariable introduction, beginning so low as to be only just audible 30-40 yds. away, and rising, and then followed after a tiny pause by the main phrase, which is pitched much higher and louder. On many occasions this phrase has reminded me very strongly of 'tit-willow', and until I discovered the bird's identity I used to think of it as 'the tit willow bird'. Another phrase, which alternated with the above fairly regularly, was roughly the same phrase reversed, with slight variety in it: tyee—tyit-weei (rising—high-low/high) or sometimes tyü—teu-tewe (low—high/low-rising). Once heard these calls would not easily be forgotten; they are ringing in my ears as I write this today in England, ten years afterwards.

20-5-1943. Tweeeeeee—titwuiu (rising—high/lower/low) or tweee-eeee—tyewiu (rising—high/lower/low) and also tüüüüüüü —tuwui-i (rising—low/low-rising).

This bird also has another note, a loud, rather staccato tyit (high) . . . tyutyu (low/low) . . . tyit (high) . . . tyutyu (low/low), which appears to be given while feeding. It also has a soft, rather churring alarm note.

Rufouscapped Bush Warbler (*Horeites brunnifrons*)

Status: 19-1-1944 (B). One believed definitely identified among low bushes and herbage in mixed jungle at 5,000 ft., and several other probables seen. The only call I heard was a soft tsik . . . tsik (somewhat slurred).

Brown Hill Warbler (*Suya criniger*)

Status: Some seen on all visits on all three gardens. In May 1943 on A they seemed to me to be less numerous than in February, and in October 1944 on C, they seemed a good deal less plentiful than in the spring and summer, but this may have been due to their silence. I saw them only in the tea.

Voice: 20-5-1943. A wheezy, almost rustling double note, like a knife being sharpened: t'zeetu-t'zeetu-t'zeetu (high/low-high/low-high/low), usually given in series of 3-4 repetitions.

Blackthroated Hill Warbler (*Suya atrogularis*)

Status: May 1943, A, a pair at about 6,800 ft. in tea, believed with a nest.

April 1945, C, two seen in low brambly bushes among secondary growth at about 5,000 ft.

May-June 1945, C, 2-3 seen together, but exact date and height not noted.

Voice: 28-5-1943. A soft tp-tp-tp-tp-tp while foraging, and when disturbed a soft, scolding chrrrr-chrrrr-chrrrr.

29-5-1943. A fairly soft prri-prri-prri-prri, high-pitched and rather slurred.

25-4-1945. On my appearance one bird gave a soft, fairly high-pitched prri . . . prri . . . prri, which was 'answered' by the other bird with an equally soft, high-pitched tyip . . . tyip.

Behaviour: 28-5-1945. The bird was never still, turning this way and that all the time, twitching its long tail up and down and occasionally vibrating it up and down very rapidly for a moment. It worked its way in little spurts to the top of a bush and then flew down to the cover of the tea bushes. This performance was repeated.

Maroon Oriole (*Oriolus traillii*)

Status: None seen in January 1944, on B, or February 1943, on A, and in October 1944 on C I found only very few. In April, May and June on A and C they were plentiful and vociferous, keeping mostly to the jungle, though sometimes seen in the shade trees among the tea.

Voice: 19-5-1943. A loud, clear, rounded typical call pelelu-luiulu (high/low-rising/low) was given fairly continuously.

20-5-1943. (*a*) A rich, full pelulu (high/low).

(*b*) Teu-pweu . . . pulelulu (high/lower-lower/low . . . low/high/low/low).

(*c*) A single, rounded tyou . . . tyou (fairly low-pitched) very similar to one of the calls of the Blackheaded Oriole (*O. xanthornus*).

(*d*) Tyupeu (rising/low).

(*e*) A harsh scream for which I could find no phonetic rendering. I think this may have been an alarm call, as it was given when I appeared round a bluff which had concealed my approach.

21-5-1943. One gave a rather rasping waeiae (rising/low/high) or re-aje (high, slurred-low/higher, slurred) in addition to the usual fluting calls. This call was given when the birds came fairly close to me and shortly afterwards.

31-5-1944. The general pattern of the song seemed to be based on a phrase something like this: pe-leulu-loo (high-falling/low-higher).

30-10-1944. One perched for some minutes on the top of a small tree growing among tea bushes and gave every few seconds a harsh kwei-eir . . . kyeir pitched very low.

24-5-1943. A good example of secondary song, which I have described in detail elsewhere (Lister, 1953).

Greyheaded Myna (*Sturnia malabarica*)

Status: I saw 1-2 on A in May 1943 only, including a pair believed to be breeding.

Common Myna (*Acridotheres tristis*)

Status: Always a few about the coolie lines, and not infrequently seen foraging among the tea bushes.

Whitebacked (Hodgson's) Munia (*Uroloncha striata*)

Status: May 1944, C, at least one large flock always to be found about the same part of the hillside at about 4,700-4,800 ft.

October 1944, C. A few seen in forest.

May-June 1944, C. Two believed seen, but identity not certain.

Voice: 31-5-1944. Two birds together now and again gave a low 'chittering' call; on seeing me they gave a low prik.

4-6-1944. A party of 30-40. The whole time they kept up a rather quiet twittering, which varied a good deal in pitch and modulation from time to time.

Spotted Munia (*Uroloncha punctulata*)

Status: January 1944, B, one party of 12 or so believed seen in company with White-eyes (*Zosterops palebrosa*) among fairly dense bushes at 4,000 ft., but identity not certain beyond all doubt. May 1944, C, 1-2 in a mixed party in jungle just above the Little Rangit River.

Scarlet Finch (*Haematospiza sipahi*)

Status: 24-1-1944, B, 2 ♂s and several ♀s at 4,000 ft.

21-10-1944, C, a single ♂ at 4,500 ft.

19-4-1945, C, one ♂ and about six ♀s were among a fairly large mixed hunting party of small birds, and another single ♂ was by itself not far away.

Voice: 21-10-1944. One alone, I believe, gave a rather fluting peye . . . peye-e (all high-pitched), but I am not absolutely sure that the call came from this bird.

19-4-1945. A rather creaky kwee-i-u (high-fall-ing), not unlike the notes of a Canary (*Serinus canarius*)

Himalayan Greenfinch (*Hypacanthis spinoides*)

Status: My only record of this species was at the end of April, 1945 on C, when a small party was seen several times among shade trees in the tea at about 4,500 ft., and foraging among hard-pruned tea-bush stools. I saw them only in late afternoon and early evening.

Tree Sparrow (*Passer montanus*)

Status: Fairly plentiful on A and B, but I think rather fewer on C. Present on all visits, usually about buildings, coolie lines, etc. In April, 1945, I occasionally saw 1-2 foraging in the tea and no doubt this was a general practice.

Voice: Their note seemed to me to be more musical and rather more varied than that of the House Sparrow (*P. domesticus*).

Nepal (Hodgson's) House Martin (*Delichon nipalensis*)

Status: I saw this species only on my one visit to B in January 1944, when I found them numerous, with their headquarters apparently about some coolie lines.

Voice: 21-1-1944. The great majority of them were completely silent, but just occasionally one would give a soft, short high-pitched chi-i as it flew.

Behaviour: From about 2,000 ft. to 6,000 ft. they were continually flying round, often low over the tea bushes. One favourite form of aerobatics seemed to be to climb suddenly almost vertically for some 20-30 ft. and then dive and flatten out when quite near the bushes again. The flight was fast and even, swooping and gliding continually in a smooth flowing flight that reminded me of skating. Often they would fly past no more than 2-3 ft. from where I was standing, and then twist and double in almost incredibly 'tight' turns. If it were not for the white on them one would sometimes never see them until they were right on top of one.

Eastern Swallow (*Hirundo rustica*)

Status: Seen on all three gardens on all visits except October when I saw none. Seemed more plentiful on C than either A or B. Signs of breeding about the factory on C (about 4,500 ft.).

Striated Swallow (*Hirundo daurica*)

Status: Exactly as for Eastern Swallow, except that I saw more of this species on B in January 1944, and there semed rather fewer on C.

Grey Wagtail (*Motacilla cinerea*)

Status: One believed seen at least twice on B in January 1944, flying about tea, but identity not proved.

One seen once by stream on C at 5,000 ft. in April 1945.

Indian Tree Pipit (*Anthus hodgsoni*)

Status: January 1944, on B, numerous in small parties among the tea and about ravines, rather less so in forest.

February 1943, on A, very plentiful in fairly large parties in tea, and rather smaller parties not infrequently seen in forest.

April 1945, on C, fairly plentiful, especially in jungle, but also in tea. My note does not mention whether they were still in flocks, but at one place mentions 2-3 birds.

Voice: 21-2-1943. A rather weak tze-e—tze-e.

25-2-1943. A soft, high-pitched tsi—tsi . . . tse . . . tse-e . . . tse-e (prolonged).

Vinousbreasted (Hodgson's) Pipit (*Anthus roseatus*)

Status: 19-1-1944, B. I believe 1-2 were among tea bushes at 5,000 ft. I had a good view of one for 3-4 minutes and as it flew away, and I think I caught a glimpse of the characteristic pale yellow on the underside of the wing. In another bird, also flushed from among the tea, the touch of pale yellow under the wing was quite distinct and easy to see against the dark background of the hillside. The only call I heard was a soft tsi . . . tsi, possibly rather shorter than, but otherwise indistinguishable from the call of the Indian Tree Pipit. I feel fairly sure in my own mind that these birds were of this species, but cannot regard their identity as proved.

Upland Pipit (*Oreocorys sylvanus*)

Status: I believe I saw a single bird of this species at about 6,500 ft. above A on 28-5-1943, but the identity must remain unproven. I give my record for what it is worth.

'A large pipit attracted my attention by gliding down, singing, on outstretched wings with tail spread. It landed on a small cultivated terrace cut into the hillside (6,500 ft.) and walked about, proving the grass at its edge for food. The song was a fairly loud sityu-sityu-sityu-sityu-sityu on descending notes, when I first noticed it, and this was given while planing down. These notes were also given several times from the ground, but only 2-3 at a time and the intervals between were longer. Later, when I had passed round the corner of the path out of sight, I heard a typically Pipit-like p'se-p'se-p'se-p'se-p'se. I strongly suspect that it was given by this bird and that it was the introductory portion of the song, though I did not hear any more of the song given at the time.

Head: Pale earthy brown; greyish-white supercilium above a darkish brown eye-stripe. Upper parts: Pale earthy brown with darker brown markings. Lower parts: Greyish white, with slight darker striations across the breast.'

White-eye (*Zosterops palpebrosa*)

Status: Seemed fairly plentiful in jungle on all visits except February 1943 (A), when I probably overlooked them; no doubt they sometimes foraged among the tea bushes.

Voice: 20-5-1943. One, foraging, kept 'singing'. Some of the phrases were as follows: t'ts'ituts-itsusi (high'low-higher) . . . tu'tufissitu—tafissitu (low'high/low—low/high/low) and a low sit-tyawississi (high-low/h-i-g-h).

29-5-1943. A not very loud sisifesife (high/falling).

23-1-1944. A continual prrree-u (slightly falling).

Nepal Yellowbacked Sunbird (*Aethopyga nipalensis*)

Status: February 1943, A, 1-2 seen. April 1945, C, 1 ♂ and 2 ♀s seen on separate occasions. May-June 1945, C, at least 2 seen. October 1944, C, 1-2 seen. All in jungle.

Voice: 26-5-1943. A small, rather quiet, high-pitched si . . . si.

25-4-1945. Each short flight of a ♀ to a fresh perch was preceded by a sharp, high dzit.

27-4-1945. A ♂, foraging, frequently gave a loud, metallic dzit . . . dzit, and very often this was extended into a kind of short song, something like this: tchiss (high) . . . tchiss—iss-iss-iss (low—ris-ing—high).

Nepal Blackbreasted Sunbird (*Aethopyga saturata*)

Status: 24-10-1944. C. One believed seen in a large mixed hunting party in jungle at about 4,500 ft., but identity not proved.

Streaked Spider Hunter (*Arachnothera magna*)

Status: 30-5-1945. C. A single one seen in fairly dense mixed jungle with thick bush and bramble undergrowth at about 4,500 ft.

Voice: The call was loud, with considerable carrying power. The basis was a rather sharp tyik (high), sometimes softened into a tchik, and it was given either once, twice or three times in quick succession, though more usually twice when it sounded like tyikik or tchikik. Sometimes there was a very slight space between the repetitions.

Behaviour: I saw one several times during the morning and, assuming, as I think, that it was the same bird on each occasion, it moved about the hillside quite a lot. The first time I saw it, it was feeding among the seed-heads of a smallish tree (? species), in which a Grey Drongo and a pair of Orangebellied Chloropsis were also feeding. I saw no sign of any real antagonism between these birds, though the Spider Hunter had a slight brush with one of the Chloropsis when they both landed on the same perch. Later I saw it foraging among some low bush undergrowth growing among tree jungle several hundred yards further along the hillside. After a minute or two it flew to the canopy of a fairly large tree and then I lost it.

When feeding its movements were inclined to be rather rapid and perhaps a little jerky, though they certainly gave no impression of nervous haste and the impression I got was rather one of deftness in its actions. It explored the leaves in which it was interested from all angles, though I never saw it hanging actually upside down. The flight was surprisingly strong and rapid, with fairly fast wing-beats and slight undulations. It called in flight as well as while foraging.

Longtailed Broadbill (*Psarisomus dalhousiae*)

Status: May 1943, A, a single bird seen at 3,500 ft. in jungle.

October 1944, C, 2-3 parties seen between 4,000 ft. and 5,500 ft. in jungle, though not much in ravines.

Voice: 23-10-1944. A party of about 12 in company with a dozen or so Haircrested Drongos, called continually with a single note tse . . . tse or pwe . . . pwe, high-pitched, soft and fairly loud.

Assam Blacknaped Green Woodpecker (*Picus canus gyldenstolpei*)

Status: One seen on 25-2-1943 on A in shade trees among tea.

Voice: A rather weak, not very loud kip . . . kip.

Small Yellownaped Woodpecker (*Picus chloropus*)

Status: A few seen in April, May, June and October, on C, usually only in jungle, but once in a shade tree.

Voice: 27-4-1945. A loud kyerk.

Large Yellownaped Woodpecker (*Chrysophlegma flavinucha*)

Status: Several seen in May and June 1944 and 1-2 in October 1944, both on C in jungle.

Voice: 27-5-1944. A fairly loud, plaintive pee-u . . . pee-u (high/fall-ing).

9-6-1944. One, apparently alone, gave a sort of yelp, sounding something like kyow . . . kyow.

Paleheaded Woodpecker (*Gecinulus grantia*)

Status: 27-5-1943. One believed seen in dense tall trees in a ravine at 5,000 ft. on A, but identity not proved.

Darjeeling Pied Woodpecker (*Dryobates darjelliensis*)

Status: 22-10-1944. C. One seen in mixed tree jungle at 5,000 ft.

Voice: Called occasionally with a low puk . . . puk.

Himalayan Lesser Pied Woodpecker (*Dryobates cathpharius*)

Status: 22-10-1944. C. One seen in mixed tree jungle at 5,000 ft.

Voice: Called occasionally with a rather soft, clear pwik.

Fulvousbreasted Pied Woodpecker (*Dryobates macei*)

Status: 1-2 seen in February and May 1943 on A, in both jungle and shade trees.

Voice: 26-2-1943. An occasional low tak . . . tak.

1-3-1943. The call was a not very powerful pik . . . pik at intervals while feeding, but when the bird was excited at my presence it twice gave a shrill, rapid pik-pipipipipipipipi (low-low/rising/high/falling/low). Once as it was flying from one tree to another it gave a curious, soft, rasping kuier-kuier (low/high/low-low/high/low).

Darjeeling Pygmy Woodpecker (*Yungipicus nanus semicoronatus*)

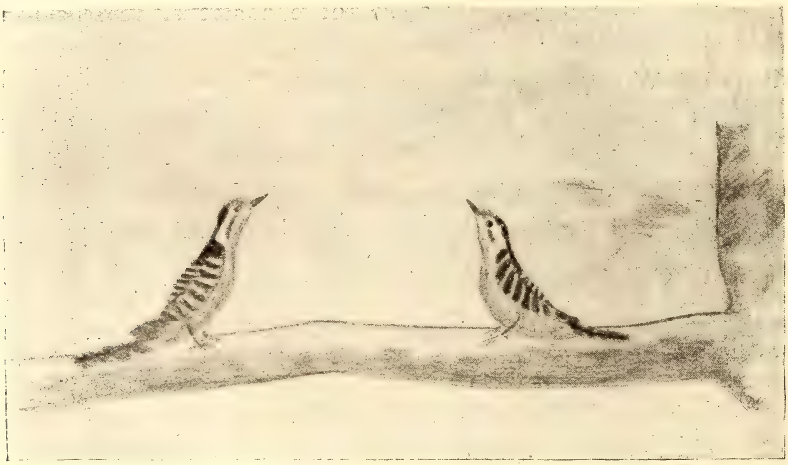
Status: 27-5-1943. A. Two seen in shade trees at 5,000 ft.

May 1944, C. Two in mixed jungle above Little Rangit River, and three in mixed jungle at about 4,700 ft.

October 1944, C. 1-2 seen in mixed jungle (height not noted).

Voice: 22-10-1944. Now and then one gave a low puk . . . puk.

Behaviour: 27-5-1943. One was feeding in the branches of a Siris tree. It moved along them with a rather jerky motion, stopping to examine a bit of bark and then advancing with little hopping movements. A few minutes later another bird arrived and they started 'formalising' (to use Edmund Selous' word). This consisted of repeatedly flying over each other for a few feet, changing places as it were, first one moving then the other, though not always alternately. There was no real evidence of enmity or antagonism. The performance struck me as more in the nature of a courtship display than a 'fight' in any sense of the word, but I could not be certain of their sexes though I saw no red on their heads. During the pauses between the little flights both birds as a rule adopted a strangely stiff upright attitude, with the body well away from the branch (though the tail was pressed close against it), and often the head pointing upwards (see fig. below). While in this attitude they kept very still and hardly made any movement. The whole performance continued for about ten minutes without a break. In the end one of the birds flew to another tree some yards away and drummed lightly.



Redeared Bay Woodpecker (*Blythipicus pyrrhotis*)

Status: 2-2-1943, A. One seen in both shade trees and mixed jungle at about 3,000 ft.

Recognition: Its movements seemed to me to be rather heavier than in the case of most other Woodpeckers, perhaps partly because of its size. Flight rather heavy and bounding.

Voice: One, foraging alone, called several times with a loud, chattering, rhythmic call p't'a-a-a-a—p't'a-a-a-a—p't'a-a-a-a—p't'a-a-a-a, pitched fairly high and all the notes the same. This phonetic rendering is a poor one, but it was the nearest I could get to it and it does give fairly accurate general description of the call, which was given rapidly with very little pause between the phrases. The *a* sound was short and sharp and not a pure *a*; it might almost have been rendered by a short staccato *e*.

Tickell's Goldenbacked Woodpecker (*Chrysocolaptes guttacristatus*)

Status: I found this species only once during all my visits—on 25-5-1945, on C, when two were present.

Voice: By answering and repeating the call of one of these birds I attracted it from 2-300 yds. away until it was in a tree almost above my head. After it had called I could see it turn its head while I answered, obviously listening, as it came nearer and nearer. When it had arrived almost above me it gave a much lower, sweeter call of a single note repeated about four times. I replied in a similar way and we kept this up for about a minute. Then another bird started calling further down the valley and my bird replied, though not so loudly as before. I too joined in, but by then I think it was realising that my calls were spoofs, and it took no further notice of me.

The normal call consisted of a repetition of a single note in series of varying length. The spacings between the repetitions of this note were sufficient to keep each repetition quite separate, but the note itself was very similar to the basis of the ordinary call of the Northern Goldenbacked Woodpecker (*Brachypternus bengalensis*). The note itself was a sharp twe-twe-tyu-tyu-tü-tü-tü usually dropping slightly in pitch after the first few repetitions. When heard close to the concentrated sharpness of the note could be heard as a sort of sudden shutting off of the sound, making it sound like tyu-ck. The love note, if such it really was, consisted of a soft, rather sweet twui-twui-twe-twe, fairly high-pitched.

Speckled Piculet (*Vivia innominata*)

Status: I saw only one, on 28-10-1944 on C, among a large mixed party of small birds in mixed deciduous trees and undergrowth at about 4,300 ft.

Rufous Piculet (*Sasia ochracea*)

Status: 22-4-1945. C. One on a clump of bamboos at 4,500 ft. One also seen in May-June 1945 on C, but details not noted.

Behaviour: 22-4-1945. My attention was first attracted by quite a loud hammering. The bird was hammering hard—almost drumming—on a stem of bamboo some 3 in. in diameter and about 20 ft. above the base. The blows were surprisingly powerful and determined for the size of the bird. After a few minutes of this it flew to another bamboo at about the same level, and then after only a short pause to another and another. Then it settled down to a fairly thorough exploration of the stem, this time not drumming, but proving the stem with a series of short, irregular but powerful taps which produced a more muffled, less ringing sound. The flight from one stem to another was in short hurried bursts, almost a scrambling flight but very swift considering the short distance covered. All its movements were quick and jerky, and I got the impression that the bird was full of compressed power, as though it were being driven by a powerful spring.

Great Himalayan Barbet (*Megalaima virens*)

Status: Plentiful on all visits, though less vociferous in October and January. It kept rather more to the jungle, but was quite often seen in the shade trees.

Voice: 18-5-1943. A low, harsh, falling kryeeeu.

19-5-1943. A continual, rather windy peaweu (high/low) every 2-3 seconds. Great carrying power.

20-5-1943. The calls today sounded more like a pilaweu (high/low/higher). With a little imagination this call might be described as 'Idhar-ao'.

27-4-1945. One perched awkwardly on a bough high above my head and gave a loud, sharp, metallic kit-tt-tt-tt—kitt-tt, fairly high-pitched.

30-5-1945. Another note sounds very like the call of a sea-gull, and this likeness is emphasised when a lot of birds are calling together.

3-6-1945. Two together called loudly with a note quite unlike any other calls I have heard. This was a very harsh grating note, starting quite softly and growing rapidly in volume until it became a loud, grating screech, very strongly suggestive of the call of some gigantic cicada. This call was given several times by both birds.

Behaviour: 27-5-1943. See under Ashy Swallow Shrike.

29-10-1944. One made a short flight from the top of a tree and caught an insect (I suspect a cicada, but could not be sure). It held it for a minute or two in its beak and then slowly swallowed it.

Bluethroated Barbet (*Cyanops asiatica*)

Status: The only time I came across this species was in April 1945 on C, when there were several about in jungle.

Goldenthroated Barbet (*Cyanops franklinii*)

Status: A few seen on all visits except May 1944 (when I must surely have forgotten to note it), but they were not nearly as plentiful as the Great Himalayan Barbet. They usually kept to the jungle and ravines, but now and again I saw one in a shade tree.

Asiatic Cuckoo (*Cuculus canorus*)

Status: May 1943, A, 1-2 heard continually, usually from about 6,000 ft. upwards. I estimated the density at probably one or a pair to 1,500 acres. I found it more usually in forest, less often in ravines or tea blocks.

May 1944, C, one heard most days at about 5,000 ft.

April 1945, C, 1-2 always to be heard.

May-June 1945, C, always a few about, but seemed more thinly distributed than the other cuckoos.

Himalayan Cuckoo (*Cuculus optatus*)

Status: January 1944, B, 1-2 heard.

February 1943, A, not recorded, but probably overlooked.

April 1945, C, numerous.

May 1943, A, fairly numerous. I estimated their density at probably one or a pair to 400-500 acres. I found them more in the ravines than the other cuckoos.

May 1944, C, plentiful all over the jungle, chiefly above 4,000 ft.

May-June 1945, C, fairly plentiful, but less vociferous than in April.

October 1944, C, 1-2 about, but apparently fewer and certainly less vociferous than in summer.

I found this species only in the jungle and ravines, and have no note of seeing them in the shade trees or tea.

Voice: 22-5-1943. Cuk-coo-coo-coo-coo (high—l-o-w) the preliminary cuk being quite soft and slightly higher in tone than the rest of the call, which was low and dull and had something of a booming quality about it. When singing the throat swelled up just like a pouter pigeon's.

25-4-1945. I have several times recently heard a low, gruff, barking prelude to the usual song. One bird I particularly listened to today introduced the song by the following phrases at various times:—

(*a*) Kyakakak (low-pitched) and some other notes which I was unable to record.

(*b*) Kakawkuku—kakakawkoku (high/low/high—high/low/rising).

Indian Cuckoo (*Cuculus micropterus*)

Status: April 1945, C, 1-2 to be heard now and again, but did not seem to be as well represented as the other cuckoos.

May 1943, A, fairly numerous. I estimated their density at one or a pair to 700-800 acres; much in ravines.

May, 1944, C, one heard most days 4,500-5,000 ft.

May-June 1945, C, usually 1-2 to be heard, generally below 4,500 ft.

I usually found this species in the jungle and ravines, but I occasionally saw one in the shade trees. Not recorded on my other visits.

Small Cuckoo (*Cuculus poliocephalus*)

Status: February 1943, A, one believed heard once in shade trees but identity not proved.

April 1945, C, one heard once.

May 1943, A, density estimated at one or a pair to 700-800 acres.

May 1944, C, several noted, scattered chiefly above 4,000 ft.

May-June 1945, C, 1-2 noted in jungle, fairly plentiful in shade trees.

Not recorded on my other visits. I found this species quite often in the shade trees as well as the jungle.

Voice: 30-5-1945. I watched one singing from only a few yards away. The song was loud and had great carrying power. The notes were measured and unhurried, and there was a roughly equal interval between them. Pik-tyik-tyi-wi-wa (high-high-higher-higher-lower)—pik-tyik-tyi-wi-wi-wa (high-high-higher-higher-lower-lower)—puk-tyuk-tyu-wu-wu-wa (low-low-high-high-high-low)—puk-tyuk-tyu-wu-wu-wa (low-low-high-high-high-low)—puk-tyuk-tyu-wa (low-low-high-low). I have heard this song given repeatedly at night as well as in the day time in May.

Large Hawk Cuckoo (*Hierococcyx sparveroides*)

Status: January 1944, B, none noted, but possibly overlooked.

February 1943, A, only one seen.

April 1945, C, numerous and vociferous.

May 1943, A, very numerous. Density estimated at one or a pair to 200-300 acres. Not found much in ravines.

May 1944, C, several heard, chiefly above 4,000 ft.

May-June 1945, C, numerous and vociferous.

I found this species mostly in jungle and only occasionally in shade trees.

Voice: 20-5-1943. The call of the birds here strikes me as being slightly different from that of the plains bird (*H. varius*), in the Delta region. Here the call sounds to me like pwe-pwuwit (high-lower/high).

25-4-1945. The birds often call many times in succession on the same note, with no *crescendo* and much less vehemence than when the song rises. I heard one bird today give the song at least 20 times in this way. Later I heard what I believe was the same bird fairly screaming its song from the top of a tall tree, repeating the series *crescendo* time after time.

3-6-1945. One gave the low, shrill introduction to the usual 'Brain-fever' song twice alone, and once was answered with the same call by another bird a few yards away.

Behaviour: See under Black Bulbul.

Plaintive Cuckoo (*Cacomantis merulinus*)

Status: I found none on A or B, but I may well have overlooked them through unfamiliarity. On C I found them fairly plentiful in April, May and June and only a few in October. This species often seems to keep to the shade trees in preference to the jungle.

Voice: 8-6-1944. This species seems to have two principal calls: (*a*) a rather mournful kiweer—kiweer—ka-ka-ka (low/high—low/high—l-o-w), the final *kas* being usually much quieter than the rest of the call; and (*b*) a call on an ascending scale, each repetition being pitched slightly higher; it usually seems to be repeated three times or occasionally four. Twe-tya-tyui—twe-tya-tyui—twe-tya-tyui (each phrase high-lower-high-rising; the second and third phrases each rather higher than the preceding one).

1-6-1945. Two in the upper branches of a large tree. At least one of them was calling continually with very loud, clear calls, most of which were as follows: k'leeu-wa-wa . . . cawur-wa-wa-wa (high-low-er . . . low/high—l-o-w-e-r). It also gave a single loud wei (fairly high-pitched) fairly frequently. Several times it also gave rudiments of the other usual call we-wa-wui (high-low-higher), but it never finished this call.

Drongo Cuckoo (*Surniculus lugubris*)

Status: January 1944, B, none noted.
February 1943, A, none noted.
April 1945, C, numerous and vociferous.
May 1943, A, 2 or more seen.
May 1944, C, fairly plentiful.
May-June 1945, C, numerous and vociferous.
October 1944, C, none noted.

Although seen quite often in shade trees I think they kept rather more to the jungle.

Voice: 9-6-1944. Its song can be heard all day long from almost any of the patches of jungle in the tea garden (C)—an ascending series of 6-7 notes pe-pe-pe-pe-pe-pe.

17-4-1945. I watched one singing for some time. It repeated the simple song with only short pauses between and then 'rested' for 3-4 minutes before singing again. It usually began the song with only four notes, then increased to five, and now and again to six. The notes were clear and regularly spaced, both in time interval and ascent of the scale, and they were invariably equally emphasised: pu-pu-pe-pe-pi. The first two notes were very slightly slurred, but the others were clear and rounded, the slight difference in inflection no doubt being produced by their approach to the upper limits of the bird's compass.

Redwinged Crested Cuckoo (*Clamator coromandus*)

Status: A single bird seen in jungle on B by the Little Rangit River in May 1944.

Field Recognition: 6-6-1944. The flight was slow and leisurely, only a foot or two above the ground. In flight the bird looked, from the side, rather like a small Crow Pheasant (*Centropus sinensis*), with red-brown wings and blackish-brown body; but seen from the front the difference was at once apparent as the bird had some white on the chest.

Large Greenbilled Malkoha (*Rhopodytes tristis*)

Status: A single bird believed seen among tea at 4,500 ft. on 3-6-1945 on C, but identity not proved.

Broadbilled Roller (*Eurystomus orientalis*)

Status: Two seen on 6-6-1944 on C, near bottom of valley (about 2,500-3,000 ft.). In the period May-June a bird was reported (but not seen by me) from near the bottom of the valley on C, which could only have been of this species.

Voice: 6-6-1944. The only call I have heard is a persistent, short, harsh kkr . . . kkr, given all the time I had the birds under observation (and they could see me).

Whitebreasted Kingfisher (*Halcyon smyrnensis*)

Status: A single bird seen about the Little Rangit River on C in May 1944.

Hoopoe (*Upupa epops*)

Status: April 1945, C, single birds seen twice at about 4,500 ft. on a path.

Redheaded Trogon (*Harpactes erythrocephalus*)

Status: One party believed seen on several occasions in fairly dense mixed jungle at about 4,500 ft. on C in June 1945, but the identity of these birds was not established with certainty.

Nepal House Swift (*Micropus affinis*)

Status: Seemed fairly plentiful on all visits to all three gardens.

Voice: 25-5-1943. A nesting colony at the tea factory on A. The principal calls I heard were as follows:—

(*a*) A very rapid siksiksiksik—sik—sik—siksiksik all pitched on about the same note.

(*b*) A harder, much more metallic syik-syik-syik-syik and a suk-suk-suk-suk, pitched fairly high, which usually seemed to be given when the bird was near the wall, flying up towards the nesting site.

(*c*) A shivering scream chrri-i-i-i-i-i-i-i-i or chrr-r-r-r-r-r-r-r-r-r, and falling; very similar to a call of the Common Indian House Swift.

(*d*) I also heard one bird give a very low muttering, quite unlike any of the other notes, as it passed a foot or two above my head.

28-5-1943. Of about 50 birds flying round just above the hillside, one or two of them gave a low chitr once or twice, which could have been audible only a few yards away.

Whitethroated Spinetail Swift (*Hirundapus caudacutus*)

Status: 24-4-1945 to 2-5-1945. Two, sometimes three, seen above the valley almost every day.

Collared Scops Owl (*Otus bakkamoena*)

Status: 6-6-1945. C. One believed seen in a tree in dense bush and tree jungle at 4,500 ft. Beyond the fact that it was small (smaller than a Barred Owlet), that it had ear-tufts and that its general colouring was a light, rather yellowish brown, I could see no details. It kept giving a broken series of low notes, which at once reminded me of the softer notes sometimes given by the Common House Crow, and could be likened to a series of quiet soft coughs.

Barred Owlet (*Glaucidium cuculoides*)

Status: A single bird seen on 26-10-1944 on C at 4,500 ft., perched on a bamboo stump in a small ravine.

Collared Pygmy Owlet (*Glaucidium brodiei*)

Status: A single bird seen on 25 and 26-2-1943 on A at close quarters in jungle. Others believed heard calling at night in April 1945 on C, May 1943 on A, May 1944 on C, May and June 1945 on C, and October 1944 on C, but birds not seen and identity not proved.

Voice: The call which I thought to be given by this bird was a subdued pu . . . pu . . . pu . . . (timed at every 9 seconds in one case) and kept up for many minutes without a break.

Black (King) Vulture (*Sarcogyps calvus*)

Status: Usually 1-2 to be seen in the course of a visit.

Himalayan Griffon Vulture (*Gyps himalayensis*)

Status: One believed seen soaring several times April-June 1945.

Whitebacked Vulture (*Pseudogyps bengalensis*)

Status: One or two seen April 1945, May 1944 and 1945, and June 1945.

Lämmergeier (*Gypaëtus barbatus*)

Status: Single birds believed seen February 1943, May 1944, and April, May and June 1945.

Hobby (*Falco severus*)

Status: One believed seen in dense mixed jungle at 5,500 ft. on A on 28-5-1943, but identity not proved.

Kestrel (*Cerchneis tinnunculus*)

Status: At least one seen January 1944 on A, and two seen in October 1944 on C.

Eastern Steppe Eagle (*Aquila nipalensis*)

Status: One believed seen soaring in May 1944.

Hodgson's Hawk Eagle (*Spizaëtus nipalensis*)

Status: One believed seen in May 1943 on A; one soaring just above the jungle at 5,000 ft. on C in April, 1945.

Crested Serpent Eagle (*Haematornis cheela*)

Status: Generally 1-2 about, sometimes soaring high, more often quite low.

Voice: 23-4-1945. The loud, clear call k'lee-leu-leu is audible for a great distance.

Brahminy Kite (*Haliastur indus*)

Status: Always one pair about on C, at 4,500 ft. in May 1944, but no others noticed.

Pariah Kite (*Milvus migrans govinda*)

Status: A few occasionally about, but not numerous and not mentioned in my records for January or October. Some birds may have been confused with the next species.

Blackeared Kite (*Milvus migrans lineatus*)

Status: Several identified for the first time in April 1945, on C, and 1-2 believed seen in May and June. No doubt overlooked on previous visits and possibly confused with the last-mentioned species.

Shikra (*Astur badius*)

Status: 1-2 seen in April-June 1945 on C, but none on other visits.

Voice: 2-6-1945. One gave a fairly loud, clear kiteu (high/falling) repeated three times, while carrying out aerobatics high above the hillside.

29-5-1945. One gave a loud, far-reaching kee . . . kee-kee, pitched fairly high.

Pintailed Green Pigeon (*Sphenocercus apicaudus*)

Status: May 1944, C. A pair reliably reported as breeding in a shooting box just above the Little Rangit River, though I did not see them myself.

Spotted Dove (*Streptopelia chinensis*)

Status: Plentiful in April, May and June on A and C, and a few still about in October on C. I found them almost as often in the shade trees growing among the tea as in the jungle.

Bartailed Cuckoo-Dove (*Macropygia unchall*)

Status: A single bird believed seen on 29-5-1945 on C at about 4,500 ft., but identity not proved.

Blackbacked Kalij Pheasant (*Gennaeus melanotus*)

Status: 1-2 seen on most visits, as often in tea as in jungle.

Voice: 19-1-1944. One was flushed by a dog, and as it flew down the hillside it gave a whistling psee-psee-psee-psee not at all the sort of noise one would normally expect from a pheasant.

Common Hill Partridge (*Arborophila torqueola*)

Status: Two believed seen in October 1944 on C and others believed heard; at least two believed seen in April 1945 on C, all in jungle. Although I think this identification was correct, I do not regard it as proved; it is just possible that these birds were another species of Hill Partridge.

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BACK-WATER FLORA OF THE WEST COAST OF SOUTH INDIA

BY

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AND

H. SUNANDA KAMATH, B.SC.

(With a text figure)

INTRODUCTION

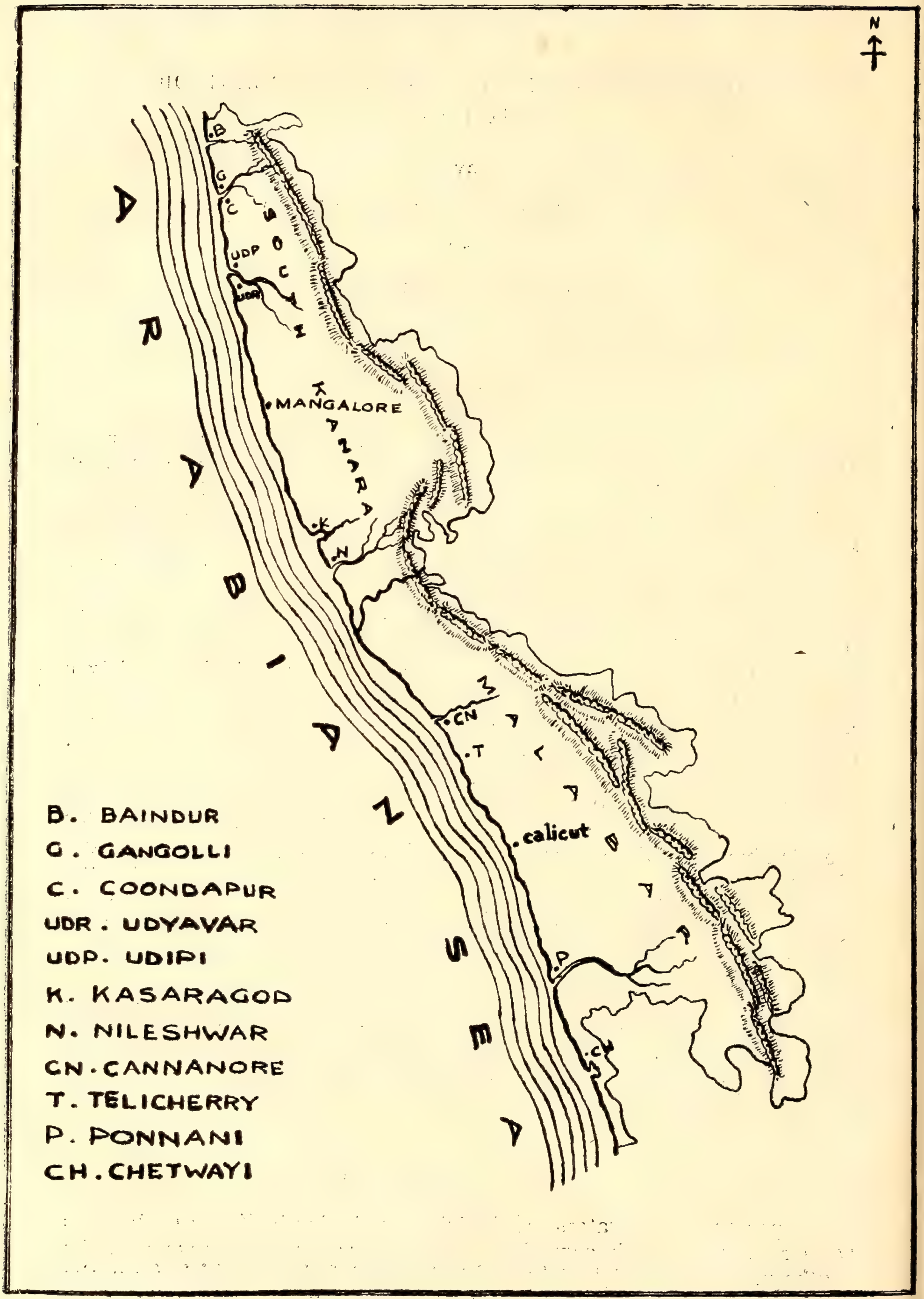
The study of the flora of the back-waters of the West Coast of Madras State was first started with a view to find out plants of economic value, if any, and incidentally to write up the flora for students of Botany in general, and Agriculture in particular. Almost all the back-water areas from Chetwayi of Ponnani (Malabar) to Baindur in Coondapur (South Kanara) have been surveyed and a general study of the type of vegetation in these tracts was made. For more intensive study, back-waters of Chetwayi, Andathode (Ponnani, Malabar) Nileshwar, Kasaragod and Coondapur (South Kanara) were surveyed. In some back-waters like Karingote River of Nileshwar, Conolly canal of Ponnani and Coondapur River, in Coondapur, a distance of 5 to 10 miles from the Sea Coast was surveyed. In this note the vegetation occurring along the foreshore of the sea and the sides and edges of the back-waters are recorded.

Venkateswaralu (1944) and Blatter (1905) have given elaborate accounts of the estuarine flora of the Godavari and the Mangrove of the Bombay Presidency respectively. The former mentions that the pioneer species occurring in the Mangrove forests are *Avicennia alba* Bl., *A. marina* Vierh., *Ceriops* Arn., *Sonneratia* L.f., and *Aegiceras* Gaertn, *Excoecaria* L., *Lumnitzera* Willd., etc., towards shallow waters. Blatter however gives detailed account of mangrove in his above work.

The distribution of the species is almost similar and the same species are repeated throughout the back-waters. To mention a few, *Rhizophora mucronata* Lamk, *Aegiceras corniculatum* Blanco, *Acanthus ilicifolius* L., *Sonneratia apetala* Buch & Ham., are among the most common species.

MATERIALS AND METHODS

Important back-waters of Malabar and South Kanara Districts were surveyed, which comprised the back-waters of Chetwayi in the southernmost part of Malabar and those of Baindur which form the northernmost boundary of South Kanara District. Usually 4 to 5 miles of the back-water from the sea-coast, were surveyed. The


N
ARABIAN SEA
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CH
B. BAINDUR
G. GANGOLLI
C. COONDAPUR
UDR. UDYAVAR
UDP. UDIPI
K. KASARAGOD
N. NILESHWAR
CN. CANNANORE
T. TELICHERRY
P. PONNANI
CH. CHETWAYI

plants collected were identified and their vernacular names and economic importance if any, have been recorded.

Gamble (1915) and Hooker (1875) have recorded some of these plants mentioned in this paper and these have been incorporated at appropriate places.

Chandrasekhara Ayyar, *et al.* (1949) have given a list of plants found in these back-waters that can be grown for green manure purposes in saline areas; the collections already made in the Madras Herbarium by previous workers have also been taken into account. The details for the latter include the date and place of collection, collector's name and the Madras Herbarium sheet numbers.

In the list of plants given below the plants are arranged according to their families.

NYMPHAEACEAE

NYMPHAEA Linn.

1. *Nymphaea stellata* Willd.

Gamble:—Along back-waters in West Coast.

A large aquatic perennial herb with floating peltate leaves.

GUTTIFERAE

CALOPHYLLUM Linn.

2. *Calophyllum decipiens* Wight.

Mal: Cherupinna.
Kan: Irai.

Gamble:—Occurs on banks of rivers and back-waters in West Coast.

A moderate-sized tree with reddish-brown useful wood.

3. *Calophyllum inophyllum* L.

Tam: Pinnai.
Mal: Pinna.
Tel: Puna.
Kan: Honna.

Grows wild in the back-waters of Nileshwar and Kasaragod in South Kanara and also along sand banks (C.R.M.[1]).

A moderate-sized very ornamental tree with a reddish-brown very useful wood. The fruits yield an oil and are often collected and sold for the extraction of oil.

11th March 1916. (M.H.[2] 3106 & 3107) Wondse back-waters (South Kanara) Fruits.

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[1] C. Rajasekhara Mudaliar.

[2] Madras Herbarium.

MALVACEAE

HIBISCUS Medik.

4. *Hibiscus tiliaceus* Linn.

Tam: Malaipuvarsu.
Mal: Nirparathi.
Tel: Erragogu.

Gamble:—West Coast districts along back-waters and tidal forests from South Kanara southwards.

In both districts of Malabar and South Kanara from Gangolly (S. Kanara, southwards usually near the Coast (C.R.M.).

A much branched tree with handsome flowers and soft wood.

STERCULIACEAE

MELOCHIA Linn.

5. *Melochia corchorifolia* Linn.

Tam: Pinnak Kuppundu.
Mal: Ceruvuram.
Tel: Ganuga Pindikura.

Kasaragod sand banks of back-waters (C.R.M.).

A weed of waste places. A herb with stellate pubescence.

WALTHERIA Linn.

6. *Waltheria indica* Linn.

Tel: Nalla Benda.

Kasaragod in South Kanara on sand banks on the sides of back-waters (C.R.M.).

An undershrub with soft pubescence, ovate leaves and small yellow flowers in globose axillary clusters.

SIMARUBACEAE

SAMADERA Gaertn.

7. *Samadera indica* Gaertn.

Mal: Karingotta.

Gamble:—West Coast along back-waters in Malabar.

A small tree with elliptic oblong shining leaves reaching 10 in. by 3-4 in. and large smooth red fruit.

1850 Cleghorn (M.H. 8628) Ponnani and Karingota Back-waters Fr. (M.H. 8629) Ponnani Back-waters (Malabar) Fr.

VITACEAE

Leea Linn.

8. *Leea sambucina* Willd.

Tam : Nyekki.
Mal : Maniporandi.
Tel : Ankadosa.
Kan : Andilu.

This plant is found growing in back-waters at Kasaragod (S. Kanara) though Gamble records this plant only on the Hills (C.R.M.).

Usually a large shrub but occasionally growing into a small tree up to 30 ft. high, producing thick foliage suitable for green manure.

11th March, 1916 (M.H. 11350 & 11351) Wondse Back-waters (S. Kanara) Fr.

LEGUMINOSAE

Crotalaria Linn.

9. *Crotalaria verrucosa* L.

Tam : Vutlei Khillo.
Tel : Ghele Gherumta.

Occurs right near the edge of the sea-shore. Found mixed with *Clerodendron inerme*. Also in back-waters of Nileshwar (C.R.M.). This is found growing very near the tidal waves also. Grows to a height of 2 to 3 ft.

A much branched, herbaceous, usually annual plant with blue or white flowers. It is a plant recommended as a green manure for saline rice fields.

10. *Crotalaria striata* DC.

Tel : Munga.

Occurs in low lying areas and sandy tracts. It was also observed in the back-waters of Nileshwar (S.K.) and under extreme saline conditions on the sea-sand near the junction of the back-waters and sea in Nileshwar (C.R.M.).

An erect herbaceous shrub reaching 4 ft. in height.

This is recommended as green manure for saline tracts.

Dalbergia Lin. f.

11. *Dalbergia candenatensis* Prain.

Gamble:—Coast of Malabar, in mangrove swamps.

A stout climbing shrub with twigs often twisted into spiral hooks with white flowers.

PONGAMIA Vent.

12. *Pongamia glabra* Vent.

Tam : Ponga.
Mal: Punna.
Tel : Kanuga.
Kan: Huligili, Honge.

Gamble:—Coastal forests and on tidal river banks.

This has been noticed on the sand banks a little distance away from back-waters. (C.R.M.)

A moderate-sized nearly ever-green tree, wood moderately hard used for cart wheels and other purposes. Plant is useful as green manure for saline rice fields. The seeds give an oil used for burning and in medicine.

28th July, 1887. (M.H. 7263) Beypoor back-waters. (Malabar) Veg.

DERRIS Lour.

13. *Derris uliginosa* Benth.

Tel: Nallatiga.

Gamble :—In sea coast forests and tidal river banks on the sides of the Peninsula.

It occurs in the sea coast forest and tidal river banks of Nileshwar, Coondapur and Udipi (C.R.M. & H.S.K.[1]). It is found climbing over trees growing along muddy salt water creeks.

A large evergreen climbing shrub with rose-coloured flowers and rather large leaflets. The leaves are poisonous and not relished by cattle. Recommended as a green manure plant for planting along the sides of the back-waters.

August, 1887. (M.H. 17341) Calicut Back-waters (Malabar) Fr.

11th March, 1916 (M.H. 7349, 7351 & 7358). Wondse back-waters (S.K.) Fr.

14. *Derris canarensis* Baker.

Gamble :—In evergreen forests and along back-waters of West Coast.

A large climbing shrub with pink flowers.

MIMOSA Linn.

15. *Mimosa pudica* Linn.

Tam: Total nadi
Kan: Nachigai mullu.

This plant is found as an undergrowth in large masses at the junction of Kasaragod River and sea and also in the back-waters of Nileshwar (C.R.M.)

A diffuse undershrub with very sensitive leaves, pink flowers and bristly pods. It spreads very fast and is most troublesome and difficult to eradicate.

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[1] H. Sunanda Kamath.

RHIZOPHORACEAE

RHIZOPHORA Linn.

16. *Rhizophora mucronata* Lamk.

Tam : Kandal.
Mal : Venkatal.
Tel : Uppo-pooma.
Kan : Kandali.

Gamble :—Tidal forests on both East and West Coasts.

The Mangrove : A very common tree of both the Districts found in the back-waters of Chetwayi, Udyavar, Malpe, Coondapur, Basrur and Nileshwar (C.R.M. & H.S.K.).

A very glabrous tree often appearing buttressed by the mud being washed away from the branching aerial roots, the lower part of the stem dying off. The bark is a valuable tanning material. Wood is dark red, very hard and excellent fuel. The fruits are viviparous and as soon as they fall from the trees on the miry soil, strike root.

27th October, 1900. C. A. Barber (M.H. 19787 & 19784) Badagara (Malabar) Veg.

17. *Rhizophora candelaria* DC.

Tam : Kandal.

Gamble :—Tidal forests on both Coasts; more scarce than the preceding.

A glabrous small evergreen tree similar to the above.

CERIOPS Arn.

18. *Ceriops candolleana* Arn.

Tam : Pavrikutti.
Mal : Ann Kandal.
Tel : Gedera.

Gamble :—Tidal forests of the West Coast.

A small evergreen tree with many buttresses at the base and root excrescences as in *Rhizophora*. Bark dark red giving a good tanning material. Wood orange-red, hard and excellent fuel.

KANDELIA W. & A.

19. *Kandelia rheedi* W. & A.

Tam : Pukkandal.
Mal : Cerukandal.
Tel : Thuvar kandal.
Kan : Kandale.

Gamble :—Tidal forests of the West Coast.

Back-waters of Coondapur (C.R.M.).

A small tree with reddish-brown bark; wood soft, reddish-brown, used only for firewood. Also recommended for planting along the side of back-waters for green manure purposes.

(M.H. 19812) Coondapur B.W. (S.K.) Flowers.

BRUGUIERA Lam.

20. *Bruguiera conjugata* Merr.
Tam: Cigappukkandal.
Mal: Kandal.
Tel: Thudder poona.

Gamble:—Tidal Forests of both coasts.

A rather large evergreen tree; wood red extremely hard used for building and fuel. Recommended for planting along the sides of the back-waters for green manure.

21. *Bruguiera cylindrica* W. & A.
Tel: Veerada.

Gamble:—Tidal forests of West Coast.

A small tree with dark brown bark and red, close-grained wood.

COMBRETACEAE

LUMNITZERA Willd.

22. *Lumnitzera racemosa* Willd.
Tam: Tipparathi.
Mal: Katakantal.
Tel: Kadivi.

Gamble:—In Mangrove swamps of East and West Coast.

An evergreen tree of shrubby growth with rather small leaves. Wood used for posts and fuel.

LECYTHIDACEAE

BARRINGTONIA Forst.

23. *Barringtonia racemosa* Roxb.
Tam: Samuthram.
Mal: Samuthraccham.

Gamble:—West Coast in Malabar, along back-waters often planted for ornament.

A medium-sized ornamental tree with large flowers and large brownish-red fruits.

SONNERATIACEAE

SONNERATIA Linn.

24. *Sonneratia caseolaris* Engl.
Tam: Kinnai.
Mal: Blatti, Thirata.
Kan: Kandale.

Gamble:—West Coast along back-waters, from South Kanara southwards.

Few trees were observed in the interior of back-waters of Kasaragod. The trees reached a height of 20-30 ft. Also observed at Malpe and Coondapur (C.R.M. and H.S.K.).

A small evergreen tree with large showy flowers and large depressed-globose fruit.

11th March, 1916 (M.H. 22042)	Wondse (S.K.) Fl.
(M.H. 22044)	S. Kanara Back-waters, Fl.

UMBELLIFERAE

CENTELLA Linn.

25. *Centella asiatica* Urban.

Common in rice fields in wet places and along sand banks of back-waters in Kasaragod (C.R.M.).

A common trailing and rooting weed.

RUBIACEAE

OLDENLANDIA PLUM

26. *Oldenlandia pruinosa* O.Kze.

Gamble:—West Coast, in Malabar along back-waters.

A shrub with thin leaves and spreading flower panicles.

PAVETTA Linn.

27. *Pavetta indica* Linn.

Tam: Karanai Pavattai.
Mal: Pavatta.
Tel: Nunepatala.
Kan: Pavate.

Growing along the junction of the sea and back-water in Nileshwar and Kasaragod (C.R.M.).

A small tree or large shrub and very variable leaves. The roots and leaves are used as medicine by ayurvedic doctors. The fruits are sometimes eaten.

BORRERIA G.F.W. Mey.

28. *Borreria hispida* K. Sch.

Tam: Nutti choori.
Tel: Madana.

On sand banks of back-waters in Kasaragod (C.R.M.).

A hispid procumbent herb with long branches, pale mauve usually long tubular flowers and hard fruits.

COMPOSITAE

GRANGEA Forsk

29. *Grangea maderaspatana* Poir.

A herb usually growing prostrate on sandy soils of back-waters in Kasaragod and Udipi (C.R.M. and H.S.K.).

MYRSINACEAE

ARDISIA Swartz.

30. *Ardisia littoralis* Andr. Repos.

Gamble :—West Coast along back-waters.

A somewhat succulent shrub reaching about 3 ft. in height.

AEGICERAS Gaertn.

31. *Aegiceras corniculatum* Blanco.

Tam : Narikandal.
Tel : Dudumara.

Gamble :—Sea Coasts East and West. In Mangrove forests especially and along tidal creeks.

Along tidal creeks of Coondapur, Basrur, Nileshwar and Kasaragod (C.R.M. & H.S.K.).

A small tree growing to 5-6 ft. high; wood mostly used for fuel.

(M.H. 29595) Salt swamps of South Kanara Fl.

7th December, 1919. (M.H. 29601 to 29604) Nileshwar Backwaters (S.K.) Veg. Fl.

EBENACEAE

DIOSPYROS L.

32. *Diospyros peregrina* Gurke.

Tam : Tumbika.
Mal : Paniccha.
Tel : Tunika.

Gamble :—West Coast; on river banks and back-waters, often cultivated.

A branching evergreen tree with large coriaceous leaves which are bright red when young; wood red with darker streaks.

APOCYNACEAE

CERBERA Linn.

33. *Cerbera manghas* Linn.

Tam : Kadama.
Mal : Othalam.

Gamble :—East and West Coast, in salt swamps and back-waters.

A large area of the back-waters was found covered with these trees in Kasaragod (C.R.M.).

A moderate-sized or small tree with lanceolate or ob-lanceolate bright green fleshy leaves and large green fruit with fibrous pericarp.

21st February, 1913 (M.H. 31466, 31471) C. A. Barber Kasaragod (S.K.) Fl.

PARSONIA R. Br.

34. *Parsonia spiralis* Wall.

Gamble:—West Coast, mostly along back-waters in Travancore.

A glabrous twining shrub with large leaves up to 6 in. long 3 in. broad, the flowers white.

ASCLEPIADACEAE

TYLOPHORA R. Br.

35. *Tylophora tenuis* Blume.

Gamble:—West Coast along back-waters in Travancore.

A slender twining undershrub, the follicles linear lanceolate, 2-3 inches long.

GENTIANACEAE

LIMNANTHEMUM Gmel.

36. *Limnanthemum parvifolium* Griseb.

Gamble:—West Coast, back-waters of Travancore.

A delicate plant with many radical leaves and very long slender stems with small floating leaves under 1 in. diameter.

CONVOLVULACEAE

ANISEIA Choisy.

37. *Aniseia uniflora* Choisy.

Gamble:—West Coast, in Travancore, margins of tanks and back-waters.

A prostrate herb with many fibrous roots from the stems rooting in mud. Leaves long-petioled, elliptic oblong, flowers white.

SCROPHULARIACEAE

LIMNOPHILA R. Br.

38. *Limnophila gratissima* Bl.

Gamble:—West Coast, margins of ponds and back-waters.

A tall glabrous plant, decumbent at base and rooting at the lower nodes and then erect, flowers purple. Usually in terminal panicles of racemes with small bracts.

ILYSANTHES Raf.

39. *Ilysanthes tenuifolia* Urb.

Gamble: West Coast, Malabar and Travancore.

Has been observed in back-waters of Kasaragod (C.R.M.).

A small very slender tufted weak marsh herb with pale blue flowers.

BIGNONIACEAE

Dolichandrone Fenzl.

40. *Dolichandrone spathacea* K. Schum.
Tam : Vilpadri.
Mal : Nipongilium.

Gamble:—West Coast, South Kanara to Travancore on the banks of rivers and back-waters.

A fairly big tree rather scarce. Found on the edge of the back-waters at Kasaragod. Solitary tree also found along back-waters of Nileshwar (C.R.M.).

A big-sized deciduous tree producing abundant leaves and with white flowers which open at night and then fall off. A tree recommended to be grown along back-waters for green manure purposes.

ACANTHACEAE

Acanthus L.

41. *Acanthus ilicifolius* Linn.
Tel: Alisi, Alchi.

Gamble:—East and West Coasts, in tidal forests.

The Sea Holly. Large formations on the edge of the back-waters at Ponnani, Chirakkal, Tellichery (Malabar) and Nileswar, Kasaragod, Udipi, Basrur to Coondopur (S.K.), (C.R.M. & H.S.K.).

A gregarious shrub reaching 5 ft. in height with large blue flowers and spinous holly-like leaves, sharp spines also at the bases of the petioles.

Asystasia Blume

42. *Asystasia gangetica* T. And.

Observed growing in the back-waters of Kasaragod (C.R.M.).

A straggling often somewhat climbing perennial herb with smallish leaves and variable flowers white, blue, purple or yellow.

VERBENACEAE

Clerodendron Linn.

43. *Clerodendron inerme* Gaertn.
Tam: Pinchil.
Mal: Nirnocci.
Tel: Pisung.
Kan: Kundali.

Gamble:—Sea Coast on both sides in tidal forests often planted in gardens and so perhaps run wild in land.

At the junction of the back-waters and sea at Kasaragod. Covers a large area on the shore of the river at Nileshwar. Also on the edges of back-waters at Udyavar, Malpe and, Uliaragoli near Udipi. Often, *Derris uliginosa* is found climbing on these shrubs (C.R.M. & H.S.K.).

A straggling shrub with a brown drupe.

AVICENNIA Linn.

44. *Avicennia officinalis* Linn.

Tam: Upatham.
Mal: Orei.
Tel: Mada.
Kan: Uppoti.

Gamble:—West Coast, in South Kanara, Malabar, Cochin and Travancore along the Coast in Creeks and tidal marshes.

The White Mangrove. Back-waters of Malpe, Udyavar and Coondapur (C.R.M. & H.S.K.).

A small tree, wood grey, hard used only for fuel when others and better kinds are not available.

27th July, 1887 (M.H. 40314) Beypore (Malabar) Fl.

20th October, 1938 A.D. Calicut (M.H. 83620) Calicut (Malabar) Root.

ARISTOLOCHIACEAE

ARISTOLOCHIA L.

45. *Aristolochia indica* L.

Tam: Icuraver.
Mal: Iswaramalli.
Tel: Isara.
Kan: Iswarballi.

On the sand banks of back-waters at Kasaragod (C.R.M. & H.S.K.).

A perennial twiner with greenish white stem; a bitter plant said to be an antidote for snake-bite.

EUPHORBIACEAE

EXCOECARIA L.

46. *Excoecaria agallocha* Linn.

Tam: Tilai.
Mal: Komatti.
Tel: Tilla.

Gamble:—Tidal forests and swamps of both coasts.

Tidal shores of Kasaragod, Udyavar, Nileshwar and Coondapur (C.R.M. & H.S.K.).

An evergreen tree with poisonous milky juice. Wood, white very soft but apparently little used.

POTAMOGETONACEAE

POTAMOGETON L.

47. *Potamogeton javanicus* Hassk.

Gamble:—In back-waters, Travancore.

Floating herbs with a few submerged leaves.

CYPERACEAE

BULBOSTYLIS Kunth

48. *Bulbostylis puberula* Kunth.

On the edges of back-waters at Kasaragod (C.R.M.).

An annual herb, leaves very narrow. Stems very slender; puberulous leaves sometimes longer than the stems.

RYNCHOSPORA Vahl.

49. *Rynchospora wallichiana* Kunth.

Gamble:—In back-waters; at Travancore.

Erect herb without rhizome.

GRAMINEAE

PANICUM L.

50. *Panicum repens* L.

Tam: Tinei Pillu.
Tel: Ladda gaddi.
Kan: Santi hullu.

In sandy soils of back-waters at Udipi and at the edge of waters at Kasaragod (C.R.M. & H.S.K.).

Culms creeping at the base with distichous leaves.

SUMMARY OF RESULTS

(1) The back-waters of Malabar and South Kanara districts from Chetwayi to Baindur were surveyed up to a distance of about 4 to 5 miles from the sea-coast.

(2) The flora has been compiled, taking into account those plants already recorded by other workers.

(3) The vernacular names of plants are also given with their economic importance wherever possible.

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A NOTE ON THE POSITION OF RHINOCEROS IN THE UNION OF BURMA (1953)

BY

U. TUN YIN

In the course of official duties in the Kachin State from March 1951 to February 1952, the writer had occasion to visit Putao (Fort Hertz), Lonkhin and Hapkan in the Uyu drainage, Bhamo, Sinlum, Sadon and Lauk Naung, and collected information about the position of Rhino in the Kachin State. The writer also received information in respect of the Rhino in the Shwe-U-Daung Sanctuary.

In August 1953, Mr. E. P. Gee inquired about the Rhino population and the places where they existed. The Chief Conservator of Forests very kindly permitted the writer to go through the Annual Reports on Forest Administration 1945-46 to 1950-51, received in his office from the Conservators of Forests of the various Circles and Principal Forest Officer, Shan States.

The present note is an attempt to supplement the note prepared by Mr. W. F. H. Ansell in 1947 (*J.B.N.H.S.*, Vol. 47, No. 2, page 258 *et seq.*) and to bring it up to date.

The writer would like to express gratitude to the Chief Conservator of Forests (U Kyaw Kine), Silviculturist (U Aung Din), all the Forest Officers and Members of Parliament who have helped him in the compilation of this note.

The following is a summary of information:

Rhinoceros sondaicus The Smaller One-Horned or Javan Rhinoceros.

In 1939-40 the Game Warden (F. J. Mustell) received information 'that a Rhinoceros with calf was seen by Karen villagers in their *taungyas* at the foot of the Kyaiktiyo Hill which is situated on the border of Thaton and Pegu Districts. The villagers' description of the animal closely corresponds to that of the Javan Rhinoceros.'

These two animals were reported to be frequenting the environs of Kyaiktiyo Pogoda up to the end of the year ending the 30th September, 1949. The area has since been under occupation by the Karen insurgents, and no attempt could therefore be made to identify the species and no further information is available.

Dicerorhinus sumatrensis The Sumatran Two-Horned Rhinoceros.

(*a*) *The Shwe-U-Daung Sanctuary.*

The Divisional Forest Officer, Mong Mit Division, visited the Sanctuary in April 1948. He did not actually see one, but came across fresh tracks of rhinoceros and also a month-old spoor of a cow rhinoceros with a calf at heel. The Range Officer saw a rhinoceros in a mud wallow in May 1948. The Divisional Forest Officer, after sifting available evidence, came to the conclusion 'that despite poaching there are approximately 4-5 rhinoceros in the Mong Mit sector of the Sanctuary.'

The Range Officer, Thabeitkyin, reported (1950-51) one male, one cow and one calf rhinoceros in Katha East (Burma) sector. But in 1952 the writer learnt that three of these rare animals had been shot in the Sanctuary, one under a special licence issued to the Mahadevi of Mong Mit, for medicinal purposes, and two illicitly by the Shan hunters.

If any *D. sumatrensis* still exist in the Sanctuary, there cannot be more than two to three individuals.

The report of the Divisional Forest Officers, Mong Mit Division, and the case of the two *D. sumatrensis* referred to above should dispel the doubts of all people who are inclined to believe in the legend that the mountain spirits of Shwe-U-Daung do not like poaching.

(*b*) *Arakan Yoma.*

Thiri Pyanchi U Son Nein, M.P. Chin Hills, informed the writer (September 1953) that he saw fresh tracks of a rhino on Lontin Hill between Matupi and Kanpetlet, and that a villager from Paletwa also saw a rhino in Bigon forests between Matupi and Paletwa in May 1953. If not identical, this area probably adjoins the areas where during the Arakan campaign, the special patrols saw a rhino about 15 miles north-east of Paletwa in January 1944 and a second rhino about 25 miles east of Paletwa in April 1944. See the areas marked by Gen. Christison on his map. (*Journ., Bombay Nat. Hist. Soc.*, 45 (2) 1945).

The writer crossed over the Arakan Yoma from Padaung to Taungup and back to Padaung in February 1946, when he was informed of an area where rhino then existed. It may be the area marked almost midway between Sandoway and Prome by Gen. Christison on his map.

(*c*) *Pegu Yoma.*

In paragraph 55 of the Annual Report on Game Preservation in Burma for the year ending 31st March 1940, it is stated that the Divisional Forest Officer, Tharrawaddy Division, found fresh rhinoceros tracks on Sanwingan Hill. The Divisional Forest Officer, Tharrawaddy, referred to is U Aung Din, who is now Silviculturist, Burma. A Karen forester who was down in Rangoon recently informed me that there are two rhinoceros surviving in the Zamayi Reserve, Pegu Forest Division. The animals were seen in 1952. Zamayi Forest Reserve is in the upper reaches of the Pegu River.

U Aung Din informed the writer (September 1953) that he found tracks of two rhino at the source of Thounze chaung on the Pegu Yoma. U Aung Din on his revisit to the same area in 1945, took pains to enquire about the two rhino and was informed that one of the two rhino had been shot by the Karens.

Shwelaung chaung, referred to by Mr. Ansell, is a feeder of the Pegu River. The source is in the Pegu Yoma. So is Saing chaung where Messrs. Vernay and Percy Smith shot a specimen for the South Asiatic Hall of the American Museum of Natural History.

Between 1922 and 1926, the writer made several trips after bison and tsaing up Shwelaung chaung, Kawliya chaung and Baingda chaungs. The writer met a Karen hunter (Nauk To) who had shot four rhino, and was informed of a pocket on the Pegu Yoma where there were at least 4 to 6 rhino. The area is somewhere west of Penwegon on the Rangoon Mandalay line. It is possible that the area referred by Mr. Ansell 'exact locality not stated but probably north-west of Pegu', is the same area of which the writer received information in 1926. There may still be few specimens surviving in this area.

(*d*) *Uyu River Drainage Area.*

The Conservator of Forests, Northern Circle, estimated that there were about 5 rhinoceros in Nan-Ka-Za and Nan-Yoke-Chaungs, unclaimed forests, Uyu drainage, Katha West Forest Division in 1950-51.

The writer visited Lonkhin and Hpakan, in the Jade Mines in August 1951. Both the villages are on the bank of the Uyu River. At Hpakan the writer met the headman of Lassai Tract and learnt that a rhino was shot in the dense jungles near Kungsai in November 1949, that a few rhinoceros had been shot in the past and that some 3 or 4 specimens still exist in the area. As the centre for jade mining, the population of Hpakan is predominantly Chinese. The Laisai Chins often visit Hpakan to sell rhino horn and blood to the Chinese.

In December 1949 when the Deputy Commissioner, Myitkyina, was camping at Haungpa on the Chindwin River, the Laisai Duwa presented the Deputy Commissioner with a rhino horn. It is possible that this horn is from the rhino shot in November 1949.

The rhino in the Uyu drainage area would eventually be shot out.

(*e*) *Kahilu Sanctuary.*

In 1948 '*Rhinoceros sumatrensis* were reported seen occasionally'. The area has been under occupation of Karen insurgents and no report has been received since.

(*f*) *Tenasserim Peninsula.*

Annual Report on Forest Administration for the year ending 31st September 1951 from the Conservator of Forests, Marinetine Circle, merely mentions that rhinoceros are reported to exist in the unclassed forests, Victoria Point Range. The writer has not been able to obtain any information from the area. It is doubtful whether any rhino now exist in Tavoy-Mergui Forest Division. Some of the wolfram mines are situated in the areas which were once the habitat of both *Rhinoceros sondaicus* and *Dicerorhinus sumatrensis*. There has also been extensive poaching by Thais. The areas in Tavoy-Mergui Forest Division are at present under occupation by underground communists and Karen insurgents.

In the Yechaung Reserves of Ataran Division mentioned in paragraph 55 of the Annual Report on Game Preservation for the year ending 31st March 1940, there may still be an isolated specimen or two if they have not already been poached by the Thais.

The writer was at the source of Yechaung when he was urgently recalled on 2nd December 1941. The writer was then informed of a large rhino on the Tenasserim Yoma.

A statement in Mr. Ansell's note may be corrected: Mt. Mulayit is in Ataran Forest Division, Amherst District, and not in Mergui District which is in Tavoy-Mergui Forest Division.

(*g*) *Bhamo Area.* Rhino shot in early 1946.

Duwa Zau Lun, Head of the Kachin State, very kindly furnished the writer with a sketch map showing the track of the rhino. The rhino first seen in the Kauk-Kwa valley, crossed the Irrawaddy River, Wilatha Hills, the Taping River, a feeder of the Irrawaddy, and was eventually shot in the Maubin tract by the Shans. U Hla Pe, Lecturer, Faculty of Forests, University College, was assistant to the Divisional Forest Officer, Bhamo Division (Mr. Maxwell) in 1945-46. U Hla Pe informed the writer that the case was burked by the villagers and that he began to hear whispers long after the rhino had been shot, and was informed that the villagers did not know that the strange animal which charged the village buffaloes was a rhino, and that the rhino was shot only when the villagers came to know that the strange animal was the rare and valuable animal.

From Duwa Zau Lun's account, two facts are disclosed:—

(1) The rhino was not a wanderer from the Shwe-U-Daung Sanctuary.

(2) A rhino could swim across a river as wide as the Irrawaddy.

U Gyi Htein Nan, Finance Minister, Kachin State, was in charge of the range before his retirement from Service in the Forest Department of the Union Government. He informed the writer that a rhino had previously been shot in the Sadon Area in 1927. This area is on the east bank of the Irrawaddy and adjoins the Bhamo area. In 1931 a rhinoceros crossed the Uyu drainage, came within five miles of the railway line near Nansiaung in the Katha West Forest Division and was shot by a Kachin. In 1932, another rhinoceros came over from the Uyu drainage into the Nami and Ledan valleys, Mansi-Katha Division, during the cold weather, crossed the Indaw Banmauk road in the south and headed for the Meza chaung.

In 1936 an assistant of Messrs. The Bombay Burma Trading Corporation Limited saw a rhinoceros on the left bank of the Uyu stream in Katha West Forest Division. In the same year a rhinoceros was shot by Kachins in Nanyin Kha Reserves, Myitkina Forest Division.

During December 1939 a rhinoceros was reported in the lower Uyu valley, Katha West Forest Division. U Gyi Htein Nan is definite that all these animals came from Taungthonlon, an extinct volcano North of Mansi, Katha West Forest Division. Very little is known of this region and its fauna.

(*h*) *Myitkyina Area.*

'Peacock mentions parts of Myitkyina as locations (or former locations) of *Dicerorhinus sumatrensis*' (*Journ., Bomb. Nat. Hist. Soc.*, Vol. 47 (2) p. 260, 1947).

The writer has no idea of the locations mentioned by Peacock.

When the writer visited Putao in December 1951, he was informed of a *Dicerorhinus sumatrensis* shot by a Lishu hunter on Mansi Likun Hills in 1943.

The Manse Sawbwa received the posterior horn and some dried blood.

Mr. Sanhta Seng, Parliamentary Secretary, informed the writer (September 1953) that the Kachins believe the posterior horn alone to be efficacious, the anterior horn is only a protection to the posterior horn and is of no value to Kachins.

Mr. Sanhta Seng estimated from 4 to 6 species of *D. sumatrensis* still surviving in the Nam Lang Valley.

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POISONOUS SEEDS OF INDIA

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Part I

Introduction

India possesses a variety of soils, climatic conditions and altitudes and these have naturally made the country a veritable nursery for medicinal, poisonous and food plants of all descriptions. Many of these are native to India, while others are exotics, which have been introduced and got naturalized in course of time. More than 2,000 such plants have been enumerated in the literature of indigenous medicine which are alleged to have medicinal properties of some description or other and many of these are still in use in some form or other. The majority of these plants have not yet been fully investigated.

By the metabolic activity of plants are produced not only the food materials so essential for life, but also certain other substances, such as alkaloids, glucosides, toxalbumins, essential oils, resins, bitter principles etc. Some of these principles are so powerful and toxic that death may ensue when these enter the human or animal system in sufficient strength.

Whatever be the significance of toxic substances found in the vegetable kingdom, the fact must be remembered that they are associated with plants which manufacture food for man and animals, without which it would be impossible to live. It should be borne in mind that they are at once our friends and our enemies. Most of the plants which are harmful to man and livestock in large quantities, produce remarkably beneficial effects in small and regulated doses. The potent properties of these poisonous plants or their parts are utilized in the treatment of diseases to alleviate the sufferings of man and animals. From the economic point of view, therefore, this group of plants is of very great importance in as much as it provides us with medicinal agents of every description. The destruction of insects, those great enemies of social and economic progress, by means of vegetable resources is becoming increasingly important in the economy of the civilized world. The poisonous plants have also been used by man for fighting his enemies and for procuring his food by killing animals by their use. To catch fish as an article of diet, man has from time immemorial utilized poisonous plants. Of great use as the poisonous plants are to mankind, their presence in our midst is also a menace to man and livestock, producing death or illness through accident, ignorance or intention. The study of poisonous plants of any country with a view to assessing their harmful properties is, therefore, of prime importance, and increased knowledge in this direction and judicious utilization of the same is bound to be of immense benefit both from the scientific, toxicological, and economic points of view.

Our knowledge of the chemical constituents of plants or their parts has advanced rapidly in recent years, and the constituents responsible for the specific physiological action of the plant or its parts have in many cases been isolated, purified, and identified as definite chemical compounds. The pharmacological action of many of these has been studied by modern methods and we are now in possession of more exact knowledge of the action of the drugs containing these constituents. A good deal of work, however, has yet to be done in connection with the isolation and elucidation of the chemical nature of many other toxic or physiologically active constituents known to be present in various plants. Quite a large number of plants known or suspected to be toxic remain uninvestigated and this is particularly the case with the Indian flora.

It is well known that different parts of a plant vary considerably in the amount of toxic principles contained in them. Thus the toxicity of the seeds, fruits, flowers, leaves, stems and roots varies considerably in almost every plant, even at the same stage of its growth. All parts of the plants are not necessarily poisonous. One or more parts of a plant may be poisonous, while the remaining ones may be quite harmless and may even form a part of the human or animal diet. The seeds of several members of the family Rosaceae contain dangerous amounts of prussic acid, while the outer fleshy portion of the fruit is commonly eaten. As an example may be cited the common instances of peach, plum, and some forms of apricots, the kernels of which may contain dangerous quantities of hydrocyanic acid but the outer portions of their fruits are quite safe and edible.

In this paper it is intended to discuss the poisonous seeds of India, and in the following pages are dealt with the names of such seed-bearing plants i.e. the source plants, their families, their English and some important Indian names, their distribution in India; the chemical constituents of the seeds, their poisonous properties and other general information so far as these are known are also indicated in each case. In addition to very careful and up-to-date library work, effort has been made to supplement already available data by additional data collected personally by the author during field work and in the course of botanical explorations in different parts of India extending over a period of several years. The information contained herein is primarily of scientific interest and will serve as a basis for future work, and it is believed will be useful as a reference work and guide for all those interested and engaged in research work on the Indian indigenous drugs, particularly the poisonous seed drugs.

The following are the abbreviations used for the vernacular names :—

Be. Bengali; Bo. Bombay; Hi. Hindi; Kash. Kashmir; Kum. Kumaon; Lep. Lepcha; Mal. Malayalam; Mar. Marathi; Nep. Nepali; Pers. Persian; Pun. Punjabi; Sans. Sanskrit; Tam. Tamil; Tel. Telugu.

1. **Abrus precatorius** Linn. (Leguminosae).

English names.—Crabs Eyes, Jequirity, Prayer Beads.

Indian names.—Be. *Gunch*; Bo. *Gungchi*; Hi. *Rati*; Sans. *Gunja*; Tam. *Gundumani*; Tel. *Guriginja*.

Distribution.—A beautiful climbing shrub found throughout the greater part of India ascending the outer Himalayas to an altitude of 3,500 ft., and is sometimes planted in gardens.

Constituents of the seeds.—Seeds contain the toxalbumin, 'abrin' consisting of a globulin and a proteose (1). Seeds also contain a crystalline nitrogenous compound called abrine and an amorphous glucosidic substance abraline with a mild bitter taste (2, 3, 4).

Remarks.—The seeds are intensely poisonous, their toxicity depending on the manner in which they are administered. The whole seed may be swallowed with impunity, because the outer covering is so hard that the seeds escape disintegration and the toxin is not freed. If chewed before it is swallowed half a seed may cause poisoning in man (5). Simpson and Bannerji (123) fed the seeds to horses, goats, cattle and dogs in the form of a bolus. The horses showed symptoms of poisoning after having received ½ oz. of the seed, while 2 oz. sufficed to produce death within 18 hours. If eaten uncooked, they have purgative and emetic properties and, in large doses, give rise to symptoms resembling those of cholera (7). When taken internally by women they are said to disturb the uterine functions, and to prevent conception. The seeds ground into a paste and the mass made into sharp pointed needles are used to procure criminal abortion. When powdered and introduced into the system by subcutaneous route the seeds produce fatal results. In India they are especially employed for poisoning cattle, for procuring criminal abortion and occasionally also for homicidal purposes.

Abrin is highly toxic, the lethal dose for animals being claimed to be 0.01 mg. per kilo of weight.

2. **Aconitum** (Ranunculaceae).

English names.—Aconite, Monkshood.

Distribution.—Biennial, perennial, rarely annual herbs confined to the subalpine and alpine zones of the Himalayas from Kashmir to Nepal, and extending to the hills of Assam.

Constituents.—Aconites contain a number of alkaloids of which the most important are aconitine, indaconitine, pseudaconitine, bikhaconitine, etc., besides atisine and palmatisine which are considered nonpoisonous.

Remarks.—All parts of the aconite plant are poisonous. In the case of *A. napellus* Linn. which is a foreign plant, roots, seeds and leaves are poisonous in a descending order (8). It is possible that a number of Indian aconites also behave in the same way, but this has not been definitely ascertained.

3. **Amorphophallus sylvaticus** (Roxb.) Kunth syn. *Synantherias sylvatica* Schott (Araceae).

Indian names.—Mar. *Wajramuta*; Sans. *Vanja*, *Vanakanda*.

Distribution.—A tuberous herb found in the Madras State in the Circars, Nilgiris and Coorg. Its occurrence in the Bombay State as reported by the Flora of British India and some other works has been doubted by Cooke (9).

Remarks.—The crushed seeds when applied locally produce numbness. When swallowed it instantaneously produces a most painful irritation of the tongue and lips which lasts for a long time and causes much salivation and subsequent numbness (10).

4. **Anamirta cocculus** (Linn.) Wight & Arn. syn. *A. paniculata Colebr.* (Menispermaceae).

English names.—Crow Killer, Poison Berry.

Indian names.—Be., Hi., Sans. & Tel. *Kakamari*; Bo. *Kakaphala*; Mal. *Pola.*

Distribution.—A large climbing shrub found in Assam, Eastern Bengal, Oudh, Orissa, and Konkan southwards to Ceylon.

Constituents of the seeds.—Seeds contain picrotoxin, a crystallizable nonalkaloidal compound of definite chemical composition, to the extent of about 1.5 per cent (11, 12).

Remarks.—The fruits which are highly poisonous owe their activity to the presence of picrotoxin which is contained in the seeds but not in the pericarp. In fact the pericarp is non-poisonous and an entire drupe might, therefore, pass through the body without producing untoward symptoms (14). The fruits are used in India to poison fish and crows, and rarely for poisoning cattle. Picrotoxin is a stimulant to apparently all the emissive centers of the cerebrospinal axis affecting the cerebrum, the medulla and spinal cord. It causes in all vertebrates, when given in sufficient dose, violent convulsions which are sometimes cerebral, sometimes spinal and sometimes medullary, according to the species of the animal.

5. **Anemone obtusiloba** D. Don (Ranunculaceae).

Indian names.—Kum. *Kakriya*, *Ratanjota*; Pun. *Padar*, *Ratanjota.*

Distribution.—A densely tufted perennial herb found in the temperate and alpine Himalayas, from Kashmir to Sikkim at altitudes of 7,000 to 15,000 ft. above sea level.

Remarks.—The seeds, if given internally, produce vomiting and purging.

6. **Annona reticulata** Linn. (Annonaceae).

English names.—Bullocks Heart, Common Custardapple.

Indian names.—Be. *Nona*; Bo. & Hi. *Ramphal*; Sans. *Ramphala*; Tam. *Ramachita*; Tel. *Ramphalamu.*

Distribution.—A small tree naturalized in Bengal and elsewhere. It is cultivated but not so extensively as *A. squamosa* Linn.

Remarks.—Most of the information given under *A. squamosa* also holds good in the case of this plant.

7. **Annona squamosa** Linn. (Annonaceae).

English names.—Custard Apple, Sugar-Apple, Sweet Sop.

Indian names.—Be. *Luna*; Hi. *Shariphal*, *Sitaphal*; Sans. *Sitaphala*, *Suda*; Tam. *Sitapalam*; Tel. *Sitaphalamu.*

Distribution.—A tree about 20 ft. high naturalized in several parts of India. It is met with under cultivation and also as an escape.

Constituents of the seeds.—The seeds yield an oil and a resin which contains an acrid principle (7). Seeds also contain an amorphous alkaloid but no glucoside (15).

Remarks.—Subramaniam (16) has studied the plant and has concluded that the powdered seeds are fatal to insects. The powdered seeds are also powerfully irritant to the conjunctiva; a case has been reported of a life convict who, in order to escape from being sent to the Andamans, put the seed powder into his eyes and destroyed both his cornea, resulting in total blindness (17). When applied to *osuteri* the powdered seeds are irritant and said to produce abortion. The seeds are also used to kill lice.

8. **Areca catechu** Linn. (Palmae).

English names.—Areca Nut, Betel Nut.

Indian names.—Be. & Hi. *Supari*; Sans. *Akota*, *Ghonta*; Tam. *Kugagam*; Tel. *Kolapoka*.

Distribution.—A slender graceful palm extensively cultivated within the moist tropical tracts that fringe the coast of India, and practically within the belt of land that, with a few exceptions, does not extend inland for more than 200 miles and generally not above 3,000 ft. in altitude. There are large scale cultivations in southern and western India, Assam and Bengal and it flourishes well in Malabar, Kanara and Mysore. Often found in gardens where it is grown for ornamental purposes.

Constituents of the seeds.—The seeds contain the alkaloid arecoline to the extent of about 0.1 per cent which is a highly toxic substance. Other alkaloids present are guvacine, guvacoline, arecaidine and arecolidine.

Remarks.—There are various kinds of the seeds. When chewed in excess the young and undried seeds of some give rise to temporary giddiness and large doses produce griping and irritation followed by loose motions. The symptoms of poisoning resemble those of fungus poisoning (muscarine).

9. **Argemone mexicana** Linn. (Papaveraceae).

English names.—Mexican Poppy, Yellow Mexican Poppy.

Indian names.—Be. & Hi. *Shialkanta*; Sans. *Rukmini*, *Srigalakana*; Tam. *Kurukkum*; Tel. *Brahmadandi*.

Distribution.—A robust prickly herbaceous annual of American origin which has become completely naturalized in India and grows wild all over the country in waste lands and along road sides.

Constituents of the seeds.—The seeds as well as the herb contain two alkaloids, herbetine and protopine. Dragendroff found the seeds to contain an alkaloid which gave reactions closely resembling those given by morphine (14), but this plant has been shown to contain no morphine. The presence of traces of alkaloids in the expressed oil reported by earlier workers was confirmed some years back by investigations carried out at the School of Tropical Medicine, Calcutta.

Remarks.—The seeds which bear a superficial resemblance to the black mustard seeds are stated by many authors to possess narcotic properties. Moodeen Sheriff, however, claims that even in doses of two drachms and a half they are not narcotic (7). On expression the seeds yield a pale-yellow clear limpid oil to the extent of about 36 per cent which is known as 'Katakar oil' or the Argemone oil and is occasionally found as an adulterant of mustard oil in India. The adulterated oil produces a condition which is clinically indistinguishable from the disease called Epidemic Dropsy. During the course of work on the aetiology of epidemic dropsy at the School of Tropical Medicine and All India Institute of Hygiene and Public Health at Calcutta, it was found that Argemone oil was present in mustard oils incriminated in the outbreaks of this disease in many places (18).

10. **Aruncus sylvester** Kostel. syn. *Spiraea auruncus* Linn. (Rosaceae).

Distribution.—A shrub-like dioecious herb found in the Western and Central Temperate Himalayas.

Constituents of the seeds.—The seeds are stated to contain a saponin (19).

Remarks.—The seeds are stated to be poisonous.

11. **Atropa acuminata** Royle (Solanaceae).

English names.—Indian Atropa, Indian belladonna.

Indian names.—Be. *Yebruj*; Hi. *Angur shefa*; Kash. *Mait brand.*

Distribution.—A tall straight herb growing wild in the Western Himalayas from Kagan and Kashmir to Simla at altitudes of 6,000 to 11,000 ft. above sea level.

Constituents of the seeds.—Seeds contain atropine and hyoscyamine, chiefly hyoscyamine.

Remarks.—Same as for next species.

12. **Atropa belladonna** Linn. (Solanaceae).

English names.—Belladonna, Deadly Nightshade.

Indian names.—Kash. *Mait brand.*

Distribution.—An erect herb cultivated to a small extent in Kashmir.

Constituents of the seeds.—Seeds contain atropine and hyoscyamine, the total alkaloidal content being about 0.8 per cent chiefly hyoscyamine (11). In the fresh condition, the seeds, ripe fruits and leaves contain the largest amount of alkaloids (72).

Remarks.—The whole fruit including the seeds are intensely poisonous and cases of poisoning are reported from all parts of the world where the belladonna plant grows and are usually accidental, due to eating the berries through ignorance. Ingestion of a few berries is sufficient to cause death.

13. **Azadirachta indica** A. Juss. syn. *Melia azadirachta* Linn. (Meliaceae).

English names.—Margosa Tree, Neem Tree.

Indian names.—Be., Hi. & Bo. *Nim*; Sans. *Nimba*; Tam. *Vembu*; Tel. *Vemu.*

Distribution.—A medium-sized evergreen tree planted all over India; grows wild in the dry forests of the Deccan.

Constituents of the seeds.—Amorphous bitter principle and a crystalline substance, margosopicrin. Seeds also contain a bitter fixed oil with objectionable odour due to the presence of sulphur compounds and some fatty acids (20). The oil from seeds contain two bitter substances (21). Seeds are reported to contain up to 45 per cent of oil.

Remarks.—Seeds are poisonous in large doses to man and some animals, producing gastro-intestinal irritation and severe purgation.

14. **Baliospermum montanum** Muell. Arg. syn. *B axillare* Blume (Euphourbiaceae).

Indian names.—Be., Hi. & Sans. *Danti*; Bo. *Dantimul*; Tam. *Niradimutta*; Tel. *Nelajidi.*

Distribution.—A stout leafy undershrub found in the outer ranges of the Himalayas from Kashmir to Bhutan up to an altitude of 3,000 ft., also in Assam, Khasia hills, Northern and Eastern Bengal, Bihar and from Central and Western India to Travancore.

Remarks.—The seeds are used as a drastic purgative, but in large doses are an acronarcotic poison. They are sometimes used as a substitute for croton seeds (*Croton tiglium* Linn.) and are often sold in the bazaars under the vernacular name of '*Jamalgota*'. The oil expressed from the seeds is also a powerful hydragogue cathartic (7).

15. **Barringtonia acutangula** (Linn.) Gaertn. (Lecythidaceae).

English names.—Indian Oak; Small Indian Oak.

Indian names.—Be. *Hijal*; Bo. *Ijal*; Hi. *Hijgal*; Sans. *Hijjala*; Tam. *Aram*; Tel. *Kadamu.*

Distribution.—A small or medium-sized tree most plentiful in Bengal, especially near the coast beyond the tidal range. Also frequently found in Kanara and Bombay along the banks of streams. It is fairly common in the Sub-Himalayan tracts, east of the Jumna, in Bihar, Orissa, Bengal, Assam, the Madhya Pradesh and South India.

Remarks.—The seeds are said to be used to stupefy fish in many parts of India (10).

16. **Barringtonia asiatica** (Linn.) Kurz syn. *B. speciosa* Forst. (Lecythidaceae).

Indian names.—Tam. *Semmuli*; Tel. *Suraponna.*

Distribution.—A rather small or moderate-sized tree, native of the Andaman Islands, Singapore and Ceylon. Also occurs on the southern Deccan Peninsula, but not in a wild state.

Constituents of the seeds.—Seeds contain 3.27 per cent of a glucosidic saponin, barringtonin, and 1 per cent of a substance designated as barringtogenetin (22). Seeds contain HCN in high concentration (23).

Remarks.—The seeds are said to be a fish poison. Kernel is used as a fish poison and for homicide and suicide (23).

17. **Barringtonia racemosa** (Linn.) Roxb. (Lecythidaceae).

English names.—Indian Oak.

Indian names.—Be. *Kunda*; Hi. *Ijjul*; Mar. *Nivar*; Sans. *Nipa*; Tam. *Isudaru*; Tel. *Kanapa.*

Distribution.—An evergreen ornamental tree common along the Western Coast from Konkan to Travancore and from the Sunderbans eastwards.

Remarks.—The seed is used as a household vermifuge in Madagascar and is stated to be a fish poison (24).

18. **Butea monosperma** (Lam.) Kuntze syn. *B. frondosa* Koen. *ex* Roxb. (Leguminosae).

English names.—Bengal Kino, Butea Gum.

Indian names.—Be. *Palas*; Bo. *Palasa*; Hi. *Dhak, Palas*; Sans. *Palasha*; Tam. *Puppalasu*; Tel. *Palasomu.*

Distribution.—A small or medium-sized tree common throughout the greater part of India up to 3,000 ft., sometimes up to 4,000 ft.

Constituents of the seeds.—Fixed oil, a small quantity of a resin and a large quantity of a water-soluble albuminoid in the seeds (25). The seeds contain 18 per cent of a yellow, tasteless oil (26). Fresh seeds contain proteolytic and lypolytic enzymes (27).

Remarks.—Maggots are killed by sprinkling the powdered seeds over them (17). The native practitioners in India use the seeds as a vermifuge against both the tapeworm and round worm. The seeds when pounded with lemon juice and applied to the skin, act as a rubefacient; when made into a paste, they are used as a remedy against ring worm (7).

19. **Canavalia ensiformis** (Linn.) DC. (Leguminosae).

English names.—Broad Bean, Sword Bean.

Indian names.—Be. *Mekhun*; Bo. *Gaivara*; Hi. *Kadsambu, Sema*; Sans. *Shimbi*; Tam. *Kattuttambattan*; Tel. *Karutamma.*

Distribution.—A perennial or biennial herb cultivated throughout India for its young tender pods and seeds which are used as vegetables.

Constituents of the seeds.—Seeds contain three globulins, concanavalin A, concanavalin B and concanavalin (28, 29), of which concanavalin A has been shown to be toxic to rabbits when a sufficiently large dose is injected (30).

Remarks.—According to Haines (31) the plant is usually grown as an annual as 'the natives say that subsequent crops of seeds are more or less poisonous.'

20. **Canavalia virosa** Wight & Arn. syn. *C. ensiformis* (Linn.) DC., var. *virosa* Baker. (Leguminosae).

English names.—Wild Sword Bean.

Indian names.—Be. *Kathshim*; Bo. *Assambal*; Hi. *Sem*; Mal. *Kattuvalamara*; Sans. *Shimbi*; Tel. *Karutamma.*

Distribution.—A climbing perennial found wild in Bundelkhand, Purnea, Puri, Angul and the other parts of India.

Remarks.—According to Haines (31) the seeds are reputed poisonous, but the young pods are sometimes eaten, the former are said to have a bitter taste.

21. **Carica papaya** Linn. (Caricaceae).

English names.—Papaya, Papeta.

Indian names.—Be. *Papeva*; Bo. *Papai*; Hi. *Papaya, Papita*; Sans. *Chirbhita*; Tam. *Pappayi*; Tel. *Boppayi.*

Distribution.—An almost branchless, soft-wooded, small tree cultivated and more or less naturalized throughout India.

Constituents of the seeds.—Seeds contain only traces of carpaine (32,33). The seeds contain 0.35 per cent alkaloid carpasemine (34). The seeds are stated to contain a glucoside and a ferment. The glucoside resembles sinigrin, and on hydrolysis yields a volatile pungent body in the same way as mustard (13). The seeds are also stated to yield an essential oil containing sulphur and nitrogenous compounds (11).

Remarks.—Seeds anthelmintic and emmenagogue. A belief in their powerful emmenagogue properties prevails among all classes of women in southern India, who assert that if a pregnant woman partakes of them even in moderate quantities, abortion will result (10).

22. **Centratherum anthelminticum** (Willd.) Kuntze syn. *Vernonia anthelmintica* Willd. (Compositae).

English name.—Purple Fleabane.

Indian names.—Be. *Babchi*; Bo. *Kalenjiri*; Hi. *Somraj*; Kum. *Kalijiri*; Sans. *Somraji*; Tam. *Sittilai*; Tel. *Nelavavili.*

Distribution.—A tall annual met with throughout India up to 5,000 ft. on the Himalayas and Khasia hills.

Constituents of the seeds.—Bitter principle in the seeds (35). The seeds contain the bitter resin (36).

Remarks.—In Travancore, the bruised seeds ground up into a paste with lime juice are largely employed for destroying pediculi in the head and body. 60 and 90 per cent alcoholic extracts of the seed resin have good anthelmintic action against thread worms (36).

23. **Cerbera manghas** Linn. syn. *C. odollam* Gaertn. (Apocynaceae)

Indian names.—Be. *Dhakur*; Mal. *Utalam*; Mar. *Sukanu*; Tam. *Udalai.*

Distribution.—A small tree or a large shrub found throughout India in the salt swamps or on the sea coast. Abundant on the Malabar Coast but not very common in the Bombay State and elsewhere.

Constituents of the seeds.—Seeds contain a glucoside named cerberin. Kernels contain cerberin and cerberoside (37).

Remarks.—Cerberin has a digitalis-like action and is very poisonous. In dogs, cats and rabbits subcutaneous injection produces vomiting, diarrhoea, paralysis of the heart and rise of blood pressure. Lethal dose for dog is 1.8 mg., for cats 3.1 mg. and for rabbits 50 mg. per kgm. (38). Cerberin and cerberoside both have a digitalis-like action, the former several times more potent in cats and frogs (37).

24. **Cheiranthus cheiri** Linn. (Cruciferae).

English names.—Banwort, Gilli-flower.

Indian names.—Be. *Khueri*; Hi. *Todrisurkh.*

Distribution.—A foreign shrub-like herb, cultivated in gardens all over India.

Constituents of the seeds.—Contains the glucoside cheiranthin which is present in the largest amount in the seeds. The seeds contain a highly active cardiac glycoside, called cheiro-toxin, which yielded strophanthidin as the aglycone (124).

Remarks.—The glucoside is a violent cardiac poison.

25. **Chenopodium ambrosioides** Linn. (Chenopodiaceae).

English name.—American Wormseed.

Indian name.—Mal. *Katuayamodakam.*

Distribution.—An erect aromatic herb found in Kashmir, the Central Punjab, Bihar, Bengal, Sylhet, Bombay State, the Deccan and in the Western Ghats of the Madras State up to 7,000 ft. above sea level.

Constituents of the seeds.—Seeds contain an essential oil and saponins. The yield of oil is 0.24 per cent (39), and is found in the largest quantity in the seeds.

Remarks.—Poisoning from the plant is not likely as it is not eaten by animals under ordinary circumstances. Cases of poisoning have, however, been recorded due to the use of the oil in medicine or by accident.

26. **Chrozophora rottleri** A. Juss *ex.* Spreng. syn. *C. plicata* Hook. *f. non* A. Juss., in Fl. Brit. Ind., in part; *C. tinctoria* Hook. *f. non* A. Juss., in Fl. Brit. Ind., in part (Euphorbiaceae).

English name.—Turnsole.

Indian names.—Hi. *Sonballi*; Mar. *Suravarta*; Pun. *Nilan*; Sans. *Suryavarta.*

Distribution.—An erect annual or sometimes perennial found in waste places, fields and by the roadside in northern, central, southern and western India. In the plains of the Punjab it is somewhat rare, but is common from Sind and the Upper Gangetic Plain southwards to Coromandel; it is not found in Malabar. From the Upper Gangetic Plain it extends to the Lower Gangetic Plain, thence into the valleys of the Brahamaputra and the Surma.

Remarks.—The seeds possess cathartic properties.

27. **Cleome felina** Linn. *f.* (Capparidaceae).

Indian name.—Mal. *Ariavila.*

Distribution.—An erect much branched annual found in the dry districts of the Deccan and Carnatic, especially on black cotton soil.

Constituents of the seeds.—It is probable that the seeds contain a sharp essential oil which is present in other members of this genus.

Remarks.—The seeds are rubifacient and vesicant.

28. **Cleome icosandra** Linn. syn. *C. viscosa* Linn. (Capparidaceae).

Indian names.—Be. *Hurhuria*; Hi. *Hurhureh*; Mar. *Harhuria*; Sans. *Suryalata*; Tam. *Nayikkadugu*; Tel. *Kukhavominta.*

Distribution.—An erect annual herb commonly met with as a weed throughout the greater part of India.

Constituents of the seeds.—Seeds contain a sharp essential oil (11) and 0.1 per cent viscosic acid and 0.04 per cent viscosin (40).

Remarks.—The seeds which are often used to adulterate mustard seeds in India are rubifacient and vesicant and according to Moodeen Sheriff (7) are much superior to mustard seeds in these respects.

29. **Colchicum luteum** Baker (Liliaceae).

Indian names.—Hi. *Hirantutiya*; Sans. *Hiranyatutha.*

Distribution.—A small plant found in the Western Temperate Himalayas from Kagan and Kashmir to Chamba at altitudes of 3,000 to 8,000 ft., usually in open grassy places. Grows abundantly near Srinagar and on roadsides from Garhi to Baramulla.

Constituents of the seeds.—Chopra and his collaborators obtained 0.41 to 0.43 per cent of an alkaloid from the seeds which has the same properties as colchicine obtained from the foreign plant *C. autumnale* Linn. and could be used thereapeutically for the same purpose (41, 42).

Remarks.—The seeds are intensely poisonous and several cases of poisoning have been reported. A few children were reported to have been poisoned at Kuldana in Rawalpindi through eating the seeds. The seeds on analysis yielded colchicine of which the hundredth part of a grain proved fatal to cats (43).

30. **Coriaria nepalensis** Wall. (Coriariaceae).

English name.—Mussoorie Berry.

Indian names.—Hi. *Masuri*; Kum. *Ayar*; Nep. *Bhojinsi*; Simla. *Archarru.*

Distribution.—A large shrub found in the outer Himalayas from the Indus to Bhutan, ascending to an altitude of 8,000 ft. in the North-West and to 11,000 ft. in Sikkim. It is also found in Manipore.

Constituents of the seeds.—Seeds of the foreign species *C. myrtifolia* Linn. contain the glucoside, coriamyrtin, which is a tetanic poison (11). It is possible that the Indian species also contains the identical glucoside.

Remarks.—Seeds stated to produce, sometimes, symptoms resembling tetanus (7).

31. **Croton oblongifolius** Roxb. (Euphorbiaceae).

Indian names.—Be. *Baragach*; Mar. *Gunsur*; Nep. *Ach*; Sans. *Bhutankusa*; Tam. *Milgunari*; Tel. *Bhutankusumu.*

Distribution.—A small deciduous tree found in the Sub-Himalayan tract from Oudh eastwards, also in Bengal, Sylhet, Chota Nagpur and in Central, Western and Southern India. It is also sometimes employed for making fences.

Constituents of the seeds.—The seeds contain the same drastic purgative oil as is found in *Croton tiglium* Linn. (11).

Remarks.—The seeds act as a strong purgative and in large quantities are poisonous. They resemble in properties those of *Croton tiglium* Linn. for which they are frequently substituted.

32. **Datura metel** Linn. (Solanaceae).

English name.—Downy Datura.

Indian names.—Mal. *Ummam*; Sans. *Dhustura*; Tam. *Vellummatti*; Tel. *Tellavummetta.*

Distribution.—A coarse herb found in the North-Western Himalayas of the Punjab and about Madras, but is not common.

Constituents of the seeds.—Seeds contain hyoscine (average 0.5 per cent) and very small amounts of hyoscyamine and atropine (44) besides minute quantities of *nor*-hyoscyamine (45). Seeds contain 0.462 per cent of alkaloids, mainly hyoscyamine (46).

Remarks.—The poisonous properties and uses are the same as those of the next species.

33. **Datura metel** Linn. var. **fastuosa** (Linn.) Narayanaswami & Badhwar, syn. *D. fastuosa* Linn. (Solanaceae).

English names.—Black Datura, Purple Datura.

Indian names.—Be., Bo. & Hi. *Kaladhutura*; Sans. *Dhurta*; Tam. *Madumattai*; Tel. *Dutturamu.*

Distribution.—The variety *fastuosa* is the common datura of the Indian plains often met with on waste lands and roadsides and in gardens.

Constituents of the seeds.—Seeds contain 0.24 per cent of hyoscine (l-scopolamine) and small quantities of hyoscyamine and atropine (47). The seeds from China contain the highest amount (0.561 per cent) of the alkaloids (48).

Remarks.—The main interest of these Indian daturas is from the point of view of poisoning and for this purpose the seeds constitute the favourite narcotic poison used by criminals. The seeds have a bitter acrid taste followed by a burning sensation in the mouth and throat. They are generally parched and reduced to a fine powder, as in this way it is easy to mix them with sugar, flour, tobacco, etc. In the great majority of cases the motive of administration is the facilitation of theft. In India when an individual has been first drugged and then robbed, it is usually found that datura has been employed. A common form of crime with the aid of datura is road or rail robbery by professional highwaymen. Cases are also on record where by a judicious use of datura the miscreants have drugged a whole household in such a manner that they could ransack the entire house at their leisure. In all such cases the drug is administered along with betel-leaf or some other foodstuffs or even in the form of a smoke depending upon what a miscreant can manage to offer to the prospective victim. Accidental poisoning among children is not infrequently met with, but homicidal cases are rare.

34. **Datura stramonium** Linn. (Solanaceae).

English names.—Devils' Apple, Thorn Apple.

Indian names.—Be. *Sadadhutura*; Pers. *Tatulah*; Sans. *Dhattura, Kanaka*; Tam. *Emanamam*; Tel. *Dutturamu.*

Distribution.—A coarse annual found on the Himalayas from Kashmir to Sikkim up to an altitude of 9,000 ft. Also met with in hilly tracts of central and southern India.

Constituents of the seeds.—Seeds do not contain any atropine but chiefly hyoscyamine (11). The percentage of alkaloids in the seeds varies from 0.46 to 0.52 per cent (49). Dry seeds contain 0.33 and fruit 0.38 per cent of total alkaloids of which 25 per cent is scopolamine and 75 per cent hyoscyamine (50).

Remarks.—The poisonous properties of the seeds and the uses they are put to are the same as those of *D. metel* Linn. and its variety *fastuosa*. In addition it may be stated that the seeds have been known to contaminate maize, wheat and beans and have given rise to such symptoms as delirium, trachycardia, mydriasis, dryness of mouth and throat and generalized flush over the skin, etc. (51).

35. **Daucus carota** Linn. (Umbelliferae).

English name.—Carrot.

Indian names.—Be. *Gajar*; Hi. & Pun. *Gajar*; Sans. *Gajara*; Tam. *Gajjarakkilangu*; Tel. *Pitakanda.*

Distribution.—A hispid biennial with tuberous root cultivated throughout India as an article of food.

Remarks.—The seeds are popularly regarded as a powerful abortifacient and numerous cases of abortion, following their internal administration, are on record. More precise information is, however, wanted with regard to their alleged abortifacient properties.

36. **Delphinium elatum** Linn. (Ranunculaceae).

Distribution.—A sparingly branched herb found in the West Temperate Himalayas from Kashmir to Kumaon and in the inner Tibetan valleys at altitudes of 10,000 to 12,000 ft. above sea level.

Constituents of the seeds.—The seeds contain about 1 per cent of alkaloids, one of which was obtained in a crystalline form and at least two other bases were present in the uncrystallized portion (52). Seeds contain alkaloid lelatine, delpheline, methyllycaconitine (53).

Remarks.—In Europe the seeds are used as insecticides. Most of the Indian species of *Delphinium* have not been properly investigated but some of the popular uses in India and the beliefs and experiences of local people strongly indicate that they are poisonous. Generally speaking, the seeds are emetic, cathartic, anthelmintic and insecticidal.

37. **Digitalis purpurea** Linn. (Scrophulariaceae).

English name.—Common Foxglove.

Distribution.—A biennial herb now grown in most gardens in Indian hill stations for ornamental purposes and also cultivated in Kashmir, Kagan Valley, the Nilgiris, etc. on a commercial scale for medicinal purposes.

Constituents of the seeds.—Seeds contain three glucosides, viz. digitalinum verum, digitonin and gitonin (54).

Remarks.—Like the leaves and roots, the seeds are also poisonous and poisoning may occur due to accidental use of them.

38. **Entada pursaetha** DC. syn. *E. scandens* Benth. (Leguminosae).

English names.—Giants' Rattle, Mackay Bean.

Indian names.—Be. *Pangra*; Bo. *Garambi*; Lep. *Kulhokrik*; Pun. *Kastorikaman*; Tam. *Sillu*; Tel. *Gilatige*.

Distribution.—A gigantic woody climber found in the Central and Eastern Himalayas ascending to 4,000 ft. above sea level in Sikkim; also in Eastern Bengal, Bihar and Orissa especially in damp forests situated at higher altitudes; also in the forests along the Ghats of the Bombay State. In the Madras State it is found in the hill forests of the Northern Circars, the Deccan and on the Western Ghats from South Kanara to Travancore in evergreen forests.

Constituents of the seeds.—Seeds contain two toxic saponins which were biologically tested with regard to their poisonous properties on fishes (55); they are also said to contain a glucoside which is hydrolyzed by emulsion (56).

Remarks.—The seeds are emetic, but the white kernels on being steeped in water and after roasting are sometimes eaten by local people. The author is informed that absence of this precaution produces deleterious effects of a narcotic nature. The seeds are used as a fish poison in some parts of India, South Africa and in the Philippine Islands.

39. **Ervatamia dichotoma** (Roxb.) Blatter syn. *Tabernaemontana dichotoma* Roxb. (Apocynaceae).

English names.—Eves Apple, Forbidden Fruit.

Indian names.—Mal. *Utalam*; Pun. *Kanerzad*; Tam. *Kattalari*.

Distribution.—A small dichotomously branched tree found in the Western Ghats, in Malabar, at low levels and is occasionally grown in gardens for ornamental purposes.

Remarks.—The seeds are said to be powerfully narcotic and poisonous producing delirium and other symptoms similar to those caused by Datura; they are said by Lindley to be purgative (7).

40. **Ginkgo biloba** Linn. (Ginkgoaceae).

English names.—Ginkgo, Maidenhair Tree.

Distribution.—A tree with deciduous leaves resembling those of the maiden-hair fern found rarely in some gardens in Northern India, such as Amritsar.

Remarks.—According to Muenscher (57) severe cases of dermatitis, resulting from handling the broken or crushed seeds, have been frequently reported. According to him cases of poisoning have also occurred from contact when the seeds were cleaned of pulp.

41. **Gynandropsis gynandra** (Linn.) Merr. syn. *G. pentaphylla* DC. (Capparidaceae).

Indian names.—Be. & Hi. *Hurhur*; Bo. *Mabli*; Sans. *Hulhul*; Tam. *Velai*; Tel. *Velakura*.

Distribution.—A strong smelling, somewhat foetid weed, abundant throughout the warmer parts of India.

Constituents of the seeds.—Seeds contain a sharp essential oil similar to the essential oil of mustard (11). Cleomin isolated from the seeds (58).

Remarks.—The seeds have anthelmintic and rubifacient properties; rubbed with oil they are used to destroy head lice. According to Watt (7) they are employed to poison fish, but this statement needs confirmation.

4 2. **Gynocardia odorata** R. Br. (Flacourtiaceae).

Indian names.—Be., Bo. & Hi. *Chaulmogra*; Lep. *Tukking*; Pers. *Brinjmogra*; Sans. *Kushthapa.*

Distribution.—A glabrous tree common in the evergreen forests of Sikkim and Assam, extending eastwards across Chittagong as far as Tenasserim.

Constituents of the seeds. The seeds freed from the shell yield about 65 per cent of a fatty oil known as gynocardia oil, which does not contain chaulmoogric acid or its homologues but consists of glycerides of linolic, palmitic, linolenic, isolinolenic and oleic acids. They also contain a cyanogenetic glucoside, gynocardin [5 per cent of shell-free seeds (59)].

Remarks.—The seed pulp is employed in Sikkim to poison fish.

43. **Hedera helix** Linn. (Araliaceae).

English names.—Barren Ivy, Bentwood.

Indian names.—Kash. *Karmora*; Kum. *Banda*; Mal. *Maravala*; Tam. *Maravalai.*

Distribution.—An evergreen climbing shrub found in the Himalayas from 6,000 to 10,000 ft. above sea level and in the Khasia hills from 4,000 to 6,000 ft.

Constituents of the seeds.—Seeds contain the glucoside α-hederin and probably certain other glucosides (61, 62).

Remarks.—The seeds are poisonous. The glucoside hederin is intensely haemolytic and acts as an irritant to the alimentary canal; causes vaso-constriction; lowers the blood-pressure; slows the heart and increases its tonus, and causes death by a paralysis of the respiration (63). For warm blooded animals 2-3 cgm. per kgm. of body weight are lethal. Cold blooded animals appear to be less susceptible (64).

44. **Hura crepitans** Linn. (Euphorbiaceae).

English name.—West Indian Sand-box Tree.

Indian names.—Tam. *Mullarasanam*; Tel. *Simaburuga.*

Distribution.—A tree indigenous to Tropical America, but now grown in many Indian gardens.

Constituents of the seeds.—Seeds contain a powerful purgative oil and also a toxalbumin resembling abrin and ricin from *Abrus precatorious* Linn., and *Ricinus communis* Linn. respectively (66).

Remarks.—The seeds of this plant are emetic, and when fresh, violently purgative.

45. **Hydnocarpus kurzii** (King) Warb. syn. *Taraktogenos kurzii* King (Flacourtiaceae).

Indian names.—Assam *Lemtam*; Burma *Kalawaso*; Lep. *Tukakunga.*

Distribution.—A tree up to 50 ft. high growing abundantly in Eastern Bengal, Tippera, Chittagong and in the evergreen forests throughout upper Assam.

Constituents of the seeds.—The seeds contain hydrocyanic acid, the yield being about 0.036 per cent of the kernels. The seeds yield the oil of chaulmoogra amounting to 38 per cent of the entire seeds and consisting of the glycerides of chaulmoogric acid, hydnocarpic acid and their lower homologues together with some palmitic acid (67). Seeds contain 30.9 per cent fixed oil (68).

Remarks.—Chaulmoogra oil is extremely irritating by whichever route it is administered. Oral administration of 3 to 4 drops produces nausea and vomiting.

46. **Hydnocarpus laurifolia** (Dennst.) Sleumer syn. *H. wightiana* Blume (Flacourtiaceae).

Indian names.—Bo. *Kowti*; Mal. *Koti*; Sans. *Garndaphala*; Tam. *Niradimmuttu*; Tel. *Niradi.*

Distribution.—A tree 30-50 ft. high common in the Western Peninsula; endemic in tropical forests along the Western Ghats from the Konkan southwards and below the Ghats in Kanara and Malabar, in damp situations especially near water. In Travancore it is found up to an altitude of 2,000 ft.

Constituents of the seeds.—Seeds contain about 44 per cent of an oil which consists of the glyceryl esters of chaulmoogric acid, hydnocarpic acid and some of their lower homologues (7). They have not been found to contain any cyanogenetic compounds (69).

Remarks.—The seed or the oil if taken internally acts as a gastro-intestinal irritant, producing vomiting and purging (7).

47. **Hyoscyamus muticus** Linn. (Solanaceae).

English name.—Indian Henbane.

Indian name.—Baluchistan *Kohibhang.*

Distribution.—A herbaceous plant found in the Western Punjab, Waziristan, Sind and Baluchistan. Experimentally being cultivated in Kashmir.

Constituents of the seeds.—Leaves, seeds, capsules, stems and roots contain the alkaloids consisting chiefly of hyoscyamine, the leaves and the seeds being comparatively rich (70, 71).

Remarks.—Same as for next species.

48. **Hyoscyamus niger** Linn. (Solanaceae).

English name.—Henbane.

Indian names.—Be. *Khorasaniajowan*; Bo. *Khorasaniowa*; Hi. *Khorasani-jamani*; Pun. *Bazrbang*; Tam. *Kurasaniyoman*; Tel. *Kurashanivaman.*

Distribution.—A more or less hairy and viscid herb with a disagreeable odour frequently found from Kashmir to Garhwal at altitudes of 5,000 to 11,000 ft.

Constituents of the seeds.—Seeds contain the alkaloid hyoscyamine and also yield a poisonous oil (72).

Remarks.—The seeds are powerfully narcotic and cases of live-stock poisoning due to them have been reported. Poisoning among children on account of eating the seeds, is also on record. It is believed that *H. pusillus* Linn. of Western Tibet and Ladakh is also poisonous.

49. **Ipomoea hederacea** (Linn.) Jacq. (Convolvulaceae).

English names.—Indian Jalap, Morning Glory.

Indian names.—Be., Bo. & Hi. *Kaladanah*; Kash. *Hybilnil*; Sans. *Shyamabija*; Tam. *Kakkatan*; Tel. *Kochu.*

Distribution.—A slender twiner found throughout India, both cultivated and apparently wild, up to 6,000 ft. above sea level on the Himalayas.

Constituents of the seeds.—Seeds contain a resin from which the resin glucoside, pharbitin, has been isolated (73, 74). The resin content varies from 14.2 to 15.3 per cent (75).

Remarks.—The seeds act as a drastic purgative and occasionally produce vomiting as well.

50. **Jatropha curcas** Linn. (Euphorbiaceae).

English names.—Poison Nut, Purging Nut.

Indian names.—Be. *Bagbherenda*; Bo. *Yerand*; Hi. *Bagberenda*; Sans. *Dravanti*; Tam. *Kattukkottai*; Tel. *Nepalemu.*

Distribution.—A shrub or small tree grown in various parts of India as a field barrier. Also found in a semi-wild condition in the vicinity of villages.

Constituents of the seeds.—Seeds contain 29 to 40 per cent of a pale-yellow acrid and irritant oil consisting of the glycerides of stearic, palmatic, myristic, oleic and linoleic acids but no hydroxy acids. The oil also contains a toxic principle which is resinolipoid in character. The seeds contain a toxalbumin known as curcin (76). Seed kernels gave fatty oil, 2 phytosterols, a phytosterlin (glucoside of phytosterol), large amount of sucrose and some resinous matter having nauseating, purging and griping effect (77).

Remarks.—'The acrid, emetic and drastic principle appears to reside chiefly in the embryo. It has been stated that if the embryo be wholly removed, four or five seeds may be used as a gentle and safe purgative' (7).

It is advisable to regard the seeds and the oil as unsafe therapeutic agents on account of their highly irritant properties.

51. **Jatropha glandulifera** Roxb. (Euphorbiaceae).

Indian names.—Be. *Lalbherenda*; Bo. & Hi. *Undarbibi*; Sans. *Nikumbha*; Tam. *Kattamanaku*; Tel. *Nepalemu.*

Distribution.—A small evergreen tree found in the Deccan and Carnatic, from the Kistna river southwards, often on black cotton soil.

Constituents of the seeds.—Seeds contain a fatty oil similar to Castor oil (11).

Remarks.—The seeds and the oil obtained from them are stated to be just as poisonous and are used for the same purposes as those of *Jatropha curcas* Linn.

52. **Jatropha gossypifolia** Linn. (Euphorbiaceae).

Indian names.—Mal. *Simayavanakku*; Tam. *Simaiyamanakku*; Tel. *Simanepalemu.*

Distribution.—A shrub occurring as a roadside weed in several States of India. Often also cultivated in gardens.

Remarks.—The seeds possess drastic purgative and emetic properties, and are almost as potent in action as those of *Jatropha curcas* Linn.

53. **Jatropha multifida** Linn. (Euphorbiaceae).

English name.—Coral Plant.

Indian names.—Sans. *Bhadradanti*; Tam. *Kattunervalam.*

Distribution.—A beautiful glabrous shrub native of South America and is commonly grown in gardens and near temples.

Constituents of the seeds.—Seeds yield 28-30 per cent of an oil which is similar to that obtained from *Jatropha curcas* Linn.

Remarks.—The seeds are just as poisonous as those of *Jatropha curcas* Linn.

54. **Lagenaria siceraria** Standil. syn. *L. vulgaris* Ser. (Cucurbitaceae).

English names.—Bottle Gourd, White-Flowered Gourd.

Indian names.—Be. *Kodulau*; Hi. *Kaddu*, *Kashiphal*; Mar. *Kadubhopla*; Pun. *Lauki*; Sans. *Tumba*; Tam. *Shorakkai*; Tel. *Sorakaya.*

Distribution.—A large climbing or trailing herb found wild in India and also extensively cultivated for the sake of its young fruits.

Constituents of the seeds.—Seeds are said to contain saponins (11).

Remarks.—The seeds are suspected to be poisonous.

55. **Lagerstroemia speciosa** (Linn.) Pers. syn. *L. flos-reginae* Retz. (Lythraceae).

English name.—Queen Crape-Myrtle.

Indian names.—Be. & Hi. *Jarul*; Bo. *Bondara*; Sans. *Arjuna*; Tam. *Pumarudu*; Tel. *Varagogu.*

Distribution.—A tree found in Eastern Bengal, Assam and in the deciduous and semi-evergreen forests of the Eastern and Western Ghats. Much cultivated for ornamental and shade purposes in other places.

Remarks.—Seeds are believed to have narcotic properties (7).

(*To be continued*)

A CONTRIBUTION TO THE FLORA OF MUSSOORIE

BY

N. A. WATTS

The number of plants that comprise the Flora of Mussoorie lie between 700 and 750 species.

From among the hundreds of specimens collected by me, the following are now here recorded as belonging to the Flora of Mussoorie for the first time. They have been checked at the Forest Research Institute by Mr. Raizada, to whom I am indebted.

Plants that have received no mention in Collet's 'Flora Simlensis' have been marked by an asterisk.

RANUNCULACEAE

Thalictrum rostellatum Hook. f. & Th.

A herb growing up to 3 ft. off walls. Flowers in panicles, with white petals. Flowering time: July to September. Locality: Barlowganj.

CRUCIFERAE

Cardamine oxycarpa Hook. f. & Anders.

A weak-stemmed herb with white flowers and long pointed pods. Flowering time: July to September. Locality: Union Church.

VIOLACEAE

Viola biflora Linn.

A small pubescent herb with yellow flowers, and black honey guides. Flowering time: July to September. Locality: Oak Grove School.

MALVACEAE

Malva verticillata Linn.

An erect herb up to 4 ft. with pink sessile flowers. Flowering time: June to September. Locality: along roadways, and the margins of ditches.

ANACARDIACEAE

Rhus punjabensis Stew.

A tree up to 30 ft. with juice that raises blisters on the skin. The flowers are yellowish-green. The leaves are pinnate with glabrous, sessile leaflets. Flowering time: April to May. Locality: Woodstock.

Papilionaceae

Trifolium pratense Linn. Purple Clover.

A herb with a decumbent stem. Heads of dark red flowers up to 1½ in. in diameter. The pods are one-seeded. Flowering time: April to July. Locality: Botanical Garden lawns.

Flemingia fruticulosa Wall.

A herb with procumbent branches. The pink flowers are enclosed in a bract. The simple leaves are up to 3 in. long. Locality: 'Mossy Falls'.

Desmodium polycarpum DC.

A large undershrub with spreading branches. The flowers are purple, up to ¼ in. long. The leaves are tri-foliate. The pod has 5 to 8 joints. Flowering time: July to August. Locality: Cart Road.

Dumasia villosa DC.

A hairy herb with yellow flowers up to ¾ in. long. The leaves are 3-foliolate. Flowering time: July to August. Locality: Barlowganj.

Umbelliferae

Bupleurum tenue Don.

A herb up to 3 ft. with yellowish-green flowers. The leaves are sessile up to 3 × ¼ in. Flowering time: June to September. Locality: Balla Hissar.

Sanicula europaea Linn.

A herb up to 3 ft. with minute white flowers. The leaves are palmately divided with 3 to 5 segments. Flowering time: June to August. Locality: 'Happy Valley'.

Caprifoliaceae

***Viburnum acuminatum** DC.

A small tree with leaves up to 5 in. long. Flowers are white with purple centres and stamens, in congested corymbs. Flowering time: August to October. Locality: Balla Hissar.

Rubiaceae

Hamiltonia suaveolens Roxb.

A shrub with leaves up to 8 in. long, fetid when crushed. Flowers are blue, in panicles. Flowering time: August to November. Locality: On walls and along roadsides.

VALERIANACEAE

Valeriana hardwickii Wall. Hardwick's Valerian.

A herb growing up to 1½ ft. with undivided leaves. Flowers are white in terminal corymbs. Flowering time: July to August. Locality: St. George's School.

COMPOSITAE

Ageratum conyzoides Linn. Floss Flower.

An erect herb up to 3 ft. The flowers are pale blue. The leaves are opposite. Flowering time: May to September. Locality: along roadsides and the edges of drains.

Conyza stricta Willd.

A rough herb up to 2½ ft. The yellow flower heads are ¼ in. in diameter. The leaves are pinnately lobed. Flowering time: June to October. Locality: 'Seven Oaks' estate.

Siegesbeckia orientalis Linn.

An erect herb up to 3 ft. The yellow flowers are in leafy panicles. Outer 5 bracts are spreading and glandular-pubescent. The leaves are opposite, coarsely toothed up to 5 in. long. Flowering time: August to October. Locality: Camel's Back Road.

* **Dahlia variabilis** Desf.

A very large type of 'Tree Dahlia', growing up to 10 to 12 ft. The flowers are pink. The leaves are compound. Flowering time: September to November. Locality: Balla Hissar.

* **Vitadenia australis** Wt.

An erect herb growing up to 10 in. The flowers are white turning to pink. The leaves are up to ½ in. long. Flowering time: March to November. Locality: Along roadsides, everywhere.

Xanthium strumarium Linn. Cocklebur.

An erect coarse herb up to 3 ft. The flowers are yellowish-green in axillary clusters. The leaves are alternate, rough and triangular. Flowering time: April to November. Locality: Balla Hissar.

GENTIANACEAE

* **Swertia lurida** Royle.

A herb growing up to 3 ft. The flowers are pink with green honey guides. The leaves are opposite. Flowering time: August to October. Locality: Waverley Convent.

Swertia angustifolia Buch-Ham.

A herb growing up to 3 ft. The flowers are white, purple dotted, with one green gland on each petal. The leaves are lanceolate, up to 2 in. long. Flowering time: August to October. Locality: Kincraig.

SOLANACEAE

* **Cestrum nocturnum** Linn. Lady of the Night.

An evergreen shrub up to 6 ft. high. The flowers are greenish-white in panicles. The leaves are up to 4 in. long. Flowering time: April to July. Locality: Wynberg School.

SCROPHULARIACEAE

* **Calceolaria mexicana** Benth. Ladies Slipper.

A herb growing up to 2 ft. The flowers are lemon-yellow and bladdery. The leaves are compound. Flowering time: August to October. Locality: Arundell.

Veronica agrestis Linn. Speedwell.

A procumbent much branched herb. The flowers are blue in terminal racemes. The ovate leaves are up to 1 in. long. Flowering time: March to October. Locality: On the banks of wet ditches.

GESNERACEAE

* **Didymocarpus tomentosa** Wt.

A herb growing up to 1 ft. The upper part of the flowering stalk is glandular-pubescent. The flowers are mauve pink. The leaves are elliptic. Flowering time: July to October. Locality: Church of the Ressurection.

* **Rhynchoglossum obliquum** Bl.

A herb growing up to 8 in., with dark blue flowers and one or two elliptic leaves. Flowering time: July to September. Locality: Barlowganj.

VERBENACEAE

Verbena officinalis Linn. Vervein.

A herb up to 3 ft. The flowers are light purple in spikes. The leaves are pinnatifid. Flowering time: April to July. Locality: Vincent Hill.

Caryopteris wallichiana Schauer.

A shrub growing up to 8 ft. The flowers are white tinged with blue, in terminal panicles. The leaves are lanceolate, opposite up to 4 in. long. Flowering time: March to April; September to November. Locality: Kincraig.

LABIATAE

Stachys sericea Wall.

A herb growing up to 4 ft. and covered with hairs. The flowers are pink with purple honey guides. The leaves are up to 4 in. long. Flowering time: June to September. Locality: Camel's Back Road.

Elsholtzia strobilifera Benth.

A herb growing up to 1 ft. The flowers are white. The leaves are up to 1 in. long. Flowering time: July to September. Locality: Woodstock.

Plectranthus rugosus Wall.

An undershrub growing up to 4 ft. The flowers are in axillary racemes, white with a purple tinge. The leaves are opposite, the lower surface being white. Flowering time: July to September. Locality: Manor House.

POLYGONACEAE

Fagopyrum esculentum Moench. Common Buckwheat.

A herb growing up to 3 ft. The flowers are faintly pink in panicles. The leaves are up to 4 in. long. Flowering time: July to September. Locality: Mossy Falls.

* **Polygonum nepalense** Linn. Pepper grass.

A diffuse herb up to 1 ft. The flowers are pink. The leaves are up to 2 in. long. Flowering time: July to September. Locality: Cart Road.

EUPHORBIACEAE

Acalypha brachystachya Hornem.

A herb growing up to 1 ft. The flower spikes are green. The leaves are alternate up to 3 in. long. Flowering time: July to October. Locality: Wynberg.

* **Euphorbia geniculata** Orteg.

A herb growing up to 3 ft. Umbellate inflorescence. The leaves are alternate, sessile up to 3 in. long. The upper leaves are whorled. Flowering time: April to June. Locality: Whimple's pool.

URTICACEAE

Boehmeria platyphylla Don.

A shrub growing up to 3 ft. The flowers are white in interrupted spikes. The leaves are ovate. Flowering time: April to June. Locality: Balla Hissar.

Elatostemma sessile Forst.

A herb growing up to 2 ft. The flowers are in heads with no involucral bracts. The leaves are ovate up to 6 in. long. Flowering time: June to October. Locality: Church of the Ressurection.

AMARYLLIDACEAE

* **Zephyranthes carinata** Herb. Wind flower.

A herb with radical leaves and pink flowers. Flowering time: June to August. Locality: Balla Hissar. 'Mossy Falls'.

LILIACEAE

Asphodelus tenuifolius Cav.

A herb growing up to 2 ft. The flowers are white with brown guides. The leaves are radical. Flowering time: July to October. Locality: Vincent Hill.

Allium rubellum Bieb.

A herb growing up to 1½ ft. The flowers are pink. The leaves are radical, up to 6 in. long. Flowering time: June to August. Locality: Cart Road.

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PERIODICITY OF THE PLANKTON DIATOMS OF THE CHILKA LAKE FOR THE YEARS 1950 AND 1951

BY

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(*With two maps and two text figures*)

INTRODUCTION

In India, literature on the diatoms of brackish and estuarine waters is very meagre. However, Iyengar and Venkataraman (1951) have made detailed analysis of the ecology and seasonal succession of diatoms in the river Cooum. Casual references to the distribution of diatoms have also been made by Biswas (1932), Venkataraman (1939), Subrahmanyan (1946) and Chacko and Ganapati (1949).

The Chilka Lake (Fig. 1), in the words of Annandale and Kemp (1915), is 'a lagoon situated on the east coast of Peninsular India and connected with the Bay of Bengal', with 'an area of about 350 sq. miles'.

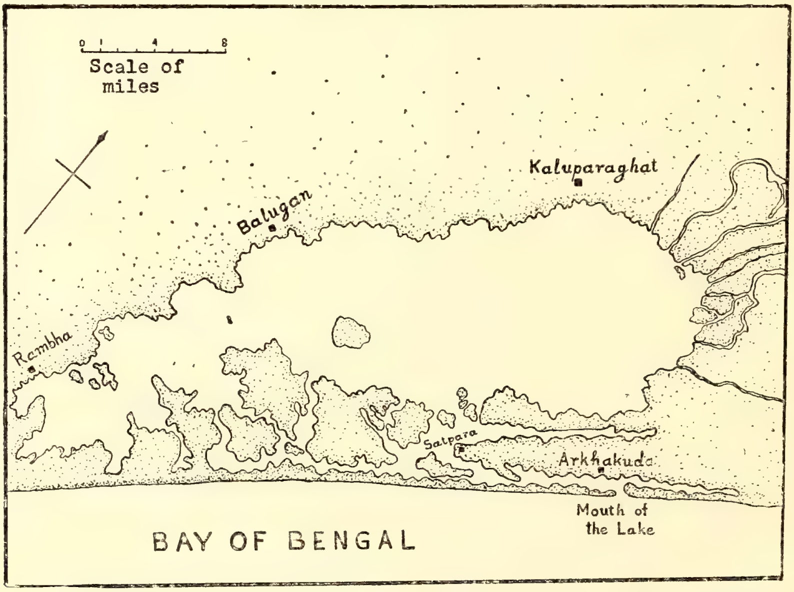


Fig. 1.—Showing the map of the Chilka Lake with five places of collection.

Biswas (op. cit.) is the pioneer to study the diatoms of the lake but his account contains merely a list of a few diatoms in their generic aspect.

Devasundaram and Roy (in press) have presented a full account of the diatoms as they occur every month during the years 1950 and 1951. Since it was a preliminary report they could not go into the details of analysis, and in the present paper an attempt is being made to give a fuller account of the diatoms, species by species, giving an emphasis on their periodicity of occurrence.

MATERIALS AND METHODS

The places of collection, materials and methods were the same as described by Devasundaram and Roy (op. cit.).

For the purpose of this paper the five places of collection have been grouped into three zones which will cover the entire lake. Each zone is characterised by a particular cycle of salinity variation (Table I).

Zone No. 1: Kaluparaghat—Balugan.
2: Rambha
3: Satpara—Arkhakuda or Outer Channel.

The first two zones represent the main area of the lake where the tidal effect is scarcely felt. The third zone is about 12 miles long and a mile broad connecting the lake to the sea through a narrow passage near Arkhakuda. In this zone the tidal effect is strongly felt.

CHEMICAL DATA

In addition to salinity and surface temperature given by the abovementioned authors, pH value of water was also recorded during each collection. In 1950 the pH varied between 8 and 9·5 and in 1951 it was between 7 and 10 (Table II).

GENERA AND SPECIES OF DIATOMS

More than forty species of diatoms spread over nineteen genera were observed in the lake. The majority of them were of marine origin and the rest were of brackishwater types. A list of the diatoms of the lake along with their usual habitat as described by Cupp (1943), Subrahmanyan (op. cit.) and Venkataraman (op. cit.) is given below.

(*i*) Marine diatoms observed in the lake	Habitat in the sea
Stephanopyxis turris (Grev.&Arn.) Ralfs	Neritic
Coscinodiscus centralis Ehrenberg	Oceanic
Rhizosolenia bergonii H. Péragallo (Figs. 2-3)	Oceanic
delicatula Cleve (Fig. 4)	Neritic
stolterfothii H. Péragallo	Oceanic
robusta Norman	Neritic
imbricata Brightwell	Neritic
styliformis Brightwell	Oceanic
setigera Brightwell	Neritic
calcar-avis M. Schultze	Oceanic
alata Brightwell	Oceanic
Bacteriastrum hyalinum Lauder	Neritic
Chaetoceros eibenii Grunow	Neritic
peruvianus Brightwell	Oceanic
lorenzianus Grunow	Neritic

TABLE I

Showing the average salinity (‰) of the three different zones of the Chilka Lake for the years 1950 & 1951

1950

Zones		Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Kaluparaghat-Balugan	...	6·92	8·23	9·66	11·83	14·34	22·01	18·33	4·31	2·42	3·15	5·45	6·15
Rambha	...	10·04	11·37	13·69	14·51	16·92	17·72	19·99	23·17	14·42	12·61	9·47	9·74
Satpara-Arkhakuda	...	5·78	19·04	24·66	26·6	29·01	30·91	23·51	8·13	5·51	4·64	3·84	3·57
						1951							
Kaluparaghat-Balugan	...	6·47	7·04	8·48	9·05	10·02	11·22	12·28	6·79	5·65	3·36	4·36	7·99
Rambha	...	9·94	9·95	10·1	10·84	10·93	10·96	14·83	24·03	14·18	12·34	12·58	11·79
Satpara-Arkhakuda	...	6·41	17·26	23·99	24·8	26·42	27·55	27·21	27·44	7·94	6·09	4·89	5·66

Table II

Showing the average pH of the three different zones of the Chilka Lake for the years 1950 & 1951

1950

Zones	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Kaluparaghat-Balugan ...	9	9·5	9·5	9·5	9·5	8·5	8·5	8·5	8	8	8·5	9
Rambha ...	9	9·5	9.5	9·5	9·5	8·5	8·5	8·5	8	8·5	9	9·5
Satpara-Arkhakuda ...	8·5	9	9·5	9·5	9·5	8·5	8·5	8·5	8·5	8	8	8·5
1951												
Kaluparaghat-Balugan ...	9·5	9·5	10	10	9	8	8	8	8	8·5	9·5	8·5
Rambha ...	9·5	9	9	9	8·5	9	8	8	9	9	9	9
Satpara-Arkhakuda ...	8	9	8	8	7	7·5	8	8	8	8·5	8	8·5

compressus Lauder	Neritic
affinis Lauder	Neritic
laevis Leuduger-Fortmorel (Fig. 5)	Neritic
curvisetus Cleve	Neritic
subtilis Cleve	Neritic
Ditylum sol Grunow	Neritic
Biddulphia sinensis Greville	Littoral
mobiliensis Bailey	Neritic
Thalassionema nitzschioides Grunow	Neritic
Thalassiothrix longissima Cleve and Grunow	Oceanic
frauenfeldii Grunow	Oceanic
Nitzschia longissima (Brebisson) Ralfs	Littoral
pungens var. *atlantica* Cleve	Neritic

(*ii*) Brackishwater diatoms observed in the lake:

Asterionella japonica cleve
Cocconeis placentula Ehr. var. *euglypta* (Ehr.) Cleve
Bacillaria paradoxa Gmelin
Nitzschia closterium (Ehrenberg) W. Smith

Besides these, one specimen each of *Melosira*? (Fig. 6), *Hemiaulus* (Figs. 7-8), *Grammatophora* (Fig. 9), *Achnanthes* (Fig. 10), *Gyrosigma* (Figs. 11-12) and a few species of *Navicula* also occurred in traces.

Some of the species given in the list above do not appear in Table III as their numerical value was very insignificant.

Of all the species *Asterionella japonica* stood out very prominently over the others in both the years.

ZONAL DISTRIBUTION OF DIATOMS IN THE LAKE

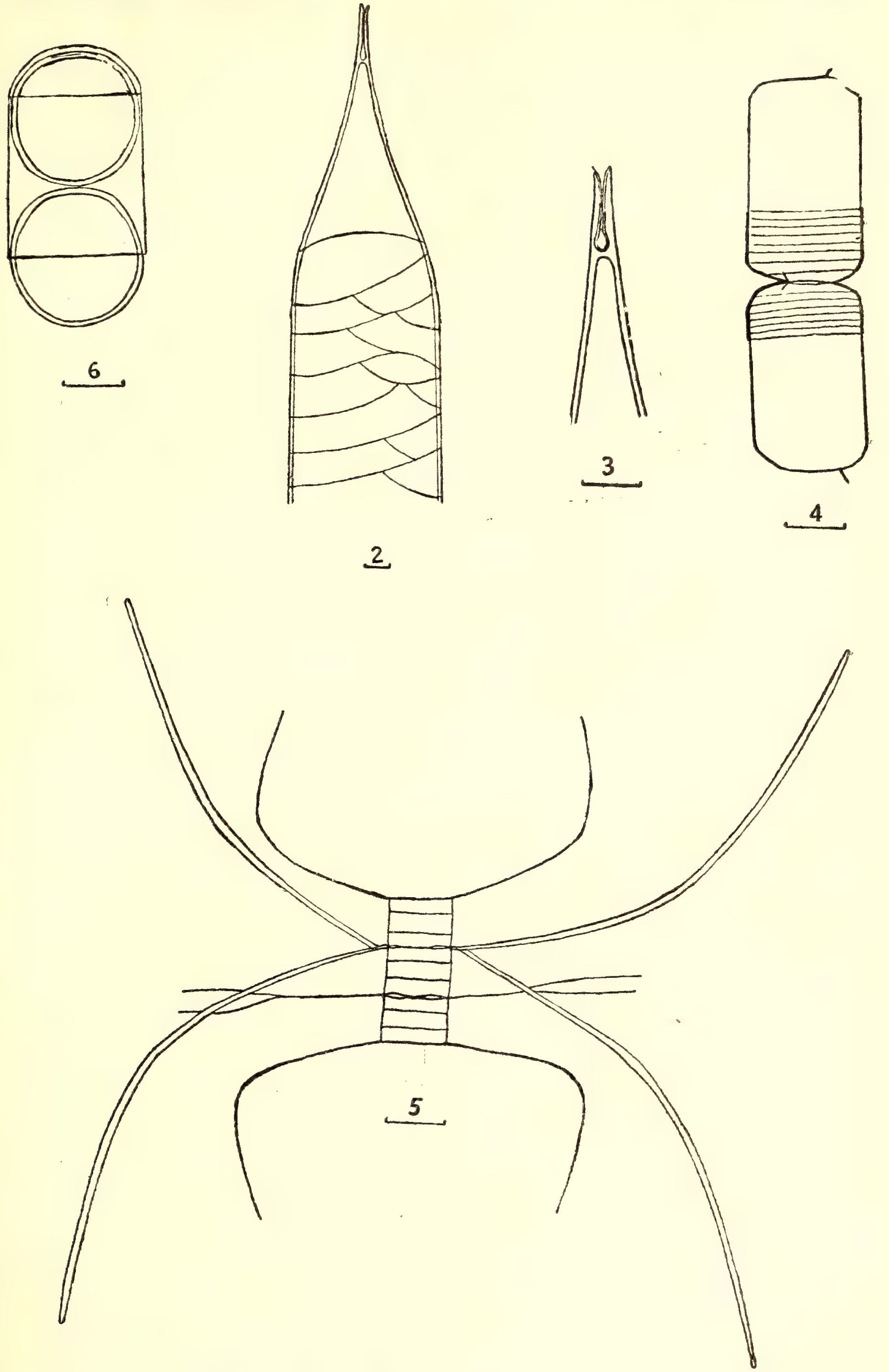
Table III shows the zonal distribution of diatoms in the lake and Table IV shows the previous record of distribution in India of the species of diatoms found in the Chilka Lake.

Kaluparaghat-Balugan Zone

Biddulphia mobiliensis, *Cocconeis placentula* var. *euglypta*, *Nitzschia closterium* were the major species of this zone in both the years. Of them *Nitzschia closterium* stood out prominently in the year 1951. It appeared in the month of February and had its maximum in April to undergo a sharp fall in May. This species, in the words of Iyengar and Venkataraman (op. cit.), 'is a halophilous mesohalobous form'. In conformity with their observation its numerical growth was augmented by the rise of salinity (from 7.04‰ to 9.05‰) but it could not be sustained due, perhaps, to the excessively high pH (from 9.5 to 10) which was constantly having an inhibitory effect on it as a result of which it had a sharp fall in May.

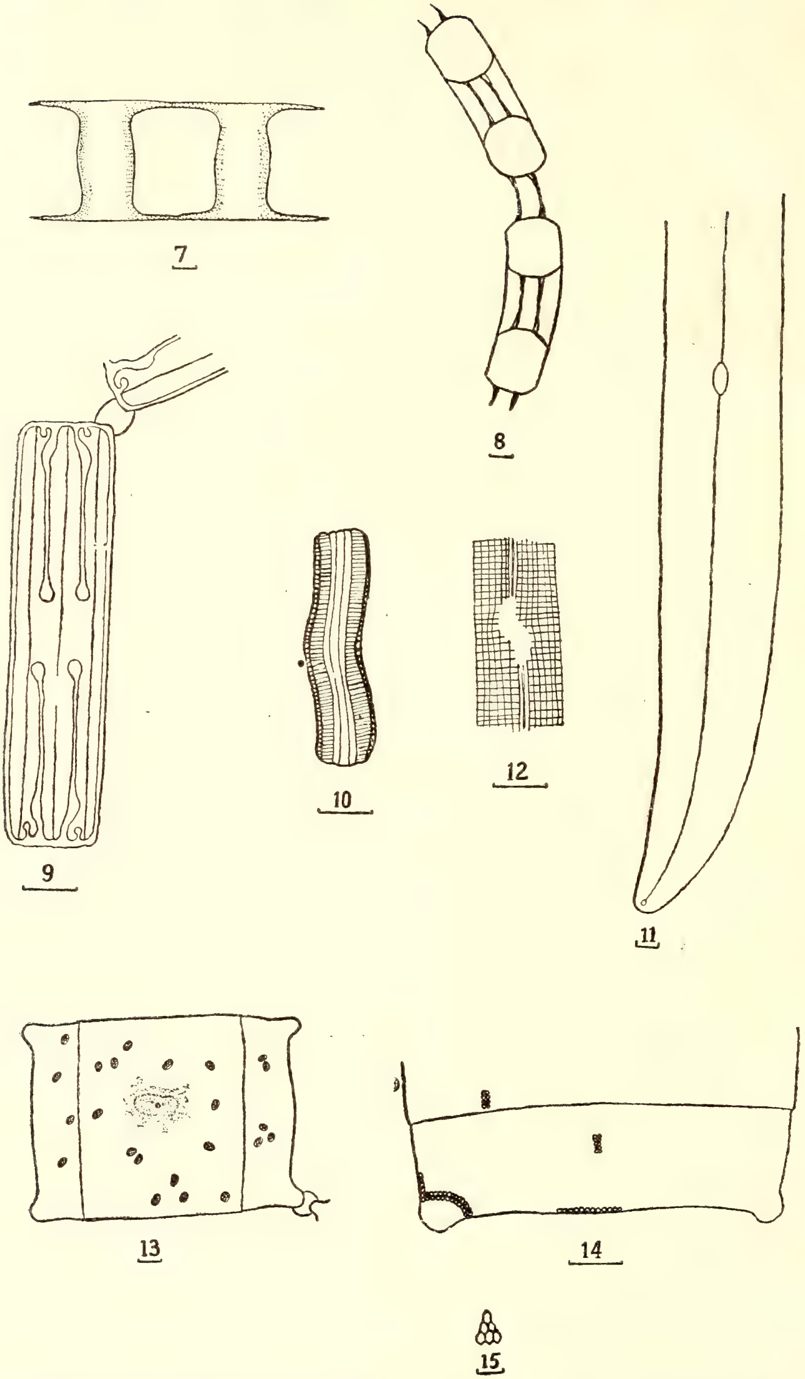
The other species which occurred next in importance is *Cocconeis placentula*. It appeared in the month of November, 1950 and May and December, 1951.

Coscinodiscus centralis, *Chaetoceros lorenzianus* and *Chaetoceros subtilis* occurred only once in the months of June, March, and December respectively in the year 1951 but they were not at all present in the year 1950. Absence



Figs. 2–6

Figs. 2–3. *Rhizosolenia bergonii* H. Pér. Fig. 2. Part of a cell showing intercalary bands; diameter, 60 ft. Fig. 3. Apex of a cell. Fig. 4. *Rhizosolenia delicatula* Cleve, part of a chain; diameter, 20μ; showing intercalary bands. Fig. 5. *Chaetoceros laevis* Leud-Fort. A chain in broad girdle view; width, 12ft.. Fig. 6. *Melosira* sp. (?), part of a chain in girdle view; diameter,24μ.



Figs. 7-15.—Figs.—7-8.—*Hemiaulus* sp. Fig. 7.—Part of chain in broad girdle view showing sculpturing on valve mantle, processes and claws, width 50μ. Fig. 8.—Part of a chain in narrow girdle view. Fig. 9. *Grammatophora* sp. Cell in broad girdle view showing intercalary bands, length 87μ. Fig. 10. *Achnanthes* sp. Cell in girdle view. Figs. 11-12. *Gyrosigma* sp. Fig. 11. Part of a cell, length 470μ, breadth 50μ. Fig. 12. Section of the centre a cell showing striations. Figs. 13-15. *Biddulphia* sp. Fig. 13. A cell in broad girdle view showing chromatophores, width 90μ. Fig. 14. Part of a cell showing sculpturing, width 75μ. Fig. 15. Sculpturing highly magnified.

of these species in the other months may go to show that this zone was not suitable for the growth and development of those species. Also, *Coscinodiscus centralis* is an oceanic species, i.e., it thrives well in such areas where there is much higher degree of salinity compared to that of this zone (11.22‰); hence it could not flourish although it occurred accidentally in this area. Perhaps the same reason holds good in the case of *Chaetoceros lorenzianus* and it is yet to be seen whether *Chaetoceros subtilis* will be represented in the subsequent year, i.e., 1952.

Besides these, *Gyrosigma* sp., *Melosira* sp. (?) were sparsely distributed in the plankton collections.

An unidentified species of *Biddulphia* (Figs. 13-15) also occurred in the month of October, 1951.

Rambha Zone

In both the years *Cocconeis placentula* occurred more frequently than the only other species *Nitzschia closterium.* It first appeared in May, 1950, had good growth in June, then disappeared completely to reappear again in September; it reached its maximum in November although it was absent in October. But in the year 1951 it was first seen in May and had its maximum in July. It was not represented in the subsequent months except in November when it had appreciable increase in quantity. There appears to be a close similarity in the occurrence of this species in the two years under review but its absence from August to October may be due to the fact that this is a fresh and slightly brackishwater species (Venkataraman, op. cit.) and the upward trend of salinity maintained in the Rambha zone upto June, instead of falling down shot up suddenly from July to August thus preventing the prospect of good growth of this species. But in November, due to the prevalence of lesser salinity, it might have reappeared.

The water was alkaline in both the years as the pH ranged between 8 and 9.5.

Satpara-Arkhakuda Zone

In this zone there was a casual sprinkling of various species of diatoms in both the years. Quantitatively June formed the peak month of occurrence of diatoms in the two years. The maximum number of species occurred in June, 1950 and in May, 1951. Thus it appears that the months of May and June formed the period of greatest incidence of diatoms. During this period the level of the lake is lower than that of the sea and the surface current in the Bay of Bengal (Fig. 16) helps the pelagic diatoms to reach the coastal waters, thus enabling the entrance of various marine species into the lake through the mouth that connects it to the sea. Perhaps that may be the only possible reason for the sudden appearance of a large number of marine specimens in the plankton catches of these two months. In the year 1950 some of them had still persisted in the month of July, although salinity had gone down from 30.91‰ to 23.51‰ but they disappeared in the next month when the salinity fell steeply to 8.13‰.

There are several swamps along the northern side of the Outer Channel and probably during the period of May-June maxima some of the diatoms

TABLE III

Showing the distribution of diatoms per litre of water in the three different zones of the Chilka Lake for the years 1950 & 1951.

1950

Species of diatoms	Kaluparaghat-Balugan													Rambha													Satpara-Arkhakuda												
	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	Total	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	Total	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	Total
Coscinodiscus centralis ...																											1			1	1	14			1				18
Rhizosolenia stolterfothii ...																																1							1
R. alata																											2		1			2							5
Bacteriastrum hyalinum ...																											1												1
Chaetoceros peruvianus ...																																4	2		1				7
C. lorenzianus																											1		1		1	31	10		2				46
C. laevis																											1					3	3		1				8
C. curvisetus																											1		1			3	2		4				11
Ditylum sol																											1			2									3
Biddulphia sinensis ...																																	1						1
B. mobiliensis							1		1				2														1			1	1	1	1						5
Thalassionema nitzschioides.																											1												1
Thalassiothrix frauenfeldii ...																											2		3										5
Asterionella japonica ...																													56	60		56	2						174
Cocconeis placentula ...											3		3					1	6			1		8		16			1										1
Nitzschia closterium ...																	1		2							3													
N. pungens																											1		5	3		3							12
Bacillaria paradoxa ...																													1	4		1							6
Total ...							1		1		3		5				1	1	8			1		8		19	13		69	71	3	119	21		9				305

1951

Stephanopyxis turris						1																								1								1
Coscinodiscus centralis													1																	3	2						1	6
Rhizosolenia bergonii																														9								9
R. delicatula																														13								13
R. stolterfothii																														20								20
R. robusta																														7								7
R. setigera																														36	1							37
R. calcar avis																											1			11								12
R. alata																														11								11
Chaetoceros eibenii																														16								16
C. peruvianus																														7								7
C. lorenzianus			1										1														2			50	2							54
C. affinis																														9	18							27
C. laevis																														7								7
C. curvisetus																														11								11
C. subtilis												4	4																	1							1	2
Biddulphia sinensis																											1											1
B. mobiliensis												1	1																	1	3						2	5
Biddulphia sp.										2			2																									
Thalassionema nitzschioides																											1			1								2
Thalassiothrix frauenfeldii																											1			3	4		1					9
Asterionella japonica																														94	332							426
Cocconeis placentula					1							1	2				3	1	7				3		14					1	1					2		4
Nitzschia closterium		1	3	11	1						1		17								2				2		1			1								2
N. longissima																															1							1
N. pungens																														11	1							12
Bacillaria paradoxa																														1	1							2
Total		1	4	11	2	1				2	1	6	28				3	1	7		2		3		16		7			325	366		1			2	3	704

found their way into them and in the month of August a few of them were banked up by the sudden onrush of floodwater from the main body of the lake but were subsequently released. That may be the reason for the occurrence of the marine forms in the month of September, 1950.

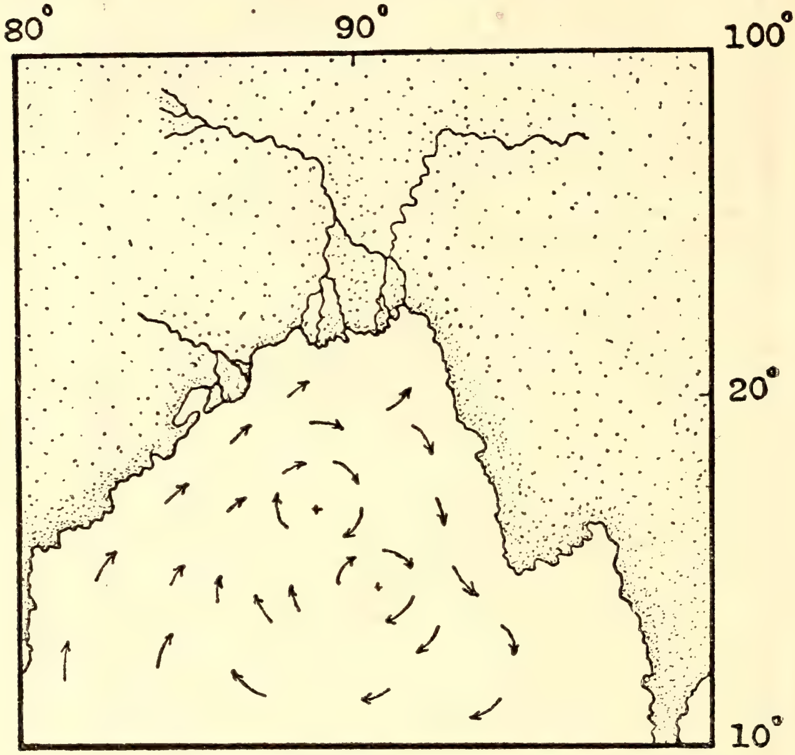


Fig. 16. Showing the surface current of the Bay of Bengal (modified after Sewell) from March to May.

The Satpara-Arkhakuda zone, situated near the mouth of the lake, is subject to strong tidal effects. As a consequence some of the marine species might have found entrance into the lake along with the tide during January to April, although they were meagre in quantity.

One notable feature in both the years is the predominance of *Asterionella japonica* over the other species. It was first observed in profuse quantity in the month of March, 1950, persisted in appearing in June and July, although it was mysteriously absent in May, But in the year 1951 it first occurred in the month of May and went suddenly higher up in June. In the Trivandrum coast the periodicity of this diatom is from April to September with its maximum in July (Menon, 1945). It is quite likely that in the Orissa coast some such seasonal distribution of this diatom with its numerical superiority over others is in existence. That may be one of the reasons for its numerical preponderance in the lake. Venkataraman (op. cit.) described this species as a marine form. Subrahmanyan (op. cit.) recorded its existence in the brackishwater and it was also found in the river Cooum by Iyengar and Venkataraman (Table IV). All these tend to show that this diatom is capable of wide adaptation to variations of salinity. Besides, high sunshine value and ample availability of nutrient material during the summer months probably helped this diatom to thrive well in the lake.

PROBABLE CAUSES OF DIATOM SCARCITY

During the winter millions of migratory ducks settle down in the lake and their excreta together with the detritus brought by the northern rivers help to increase phosphate, nitrate, and silica content of the water. These factors combined with the possibility of regular influx of marine diatoms from the Bay of Bengal ought to give a more healthy picture of diatom occurrence than what had actually been observed during the years under review. The marine diatoms which appeared in the summer months had very short span of life in the lake. The probable causes for such meagre and spurious occurrence may be as follows :

1. They are unable to withstand the sudden change from saline to freshwater at the advent of monsoon.
2. The less number of sunshine hours during the monsoon and winter may not be conducive for the production of diatom.
3. High range of pH (8 to 10) in seasons other than summer may also inhibit their natural growth. Within the range of 7.8 to 8.8 the pH does not act as a limiting factor according to Lucas and Hutchinson (1927).*
4. The grazing effect of zooplankton and fish fauna, especially since the lake is very shallow, is likely to affect the reproduction of diatoms.

ACKNOWLEDGEMENTS

I am grateful to Sri M. Peter Devasundaram, Assistant Director of Fisheries (Marine), Orissa, for the pains he took in improving the paper and to Sri G. N. Mitra, Director of Industries, Orissa, for having kindly sanctioned the publication of it.

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TABLE IV

Showing previous record of distribution in India of the species of diatoms found in the Chilka Lake in the years 1950 and 1951

Species of diatoms	Places of occurrence	Author and year of description
Stephanopyxis turris (Grev. & Arn.) Ralfs.	Malabar coast	Hornell and Nayudu (1924)
	Trivandrum coast	Menon (1945)
	Madras coast	Subrahmanyan (1946)
Coscinodiscus centralis Ehr.	Madras coast	Subrahmanyan (1946)
Rhizosolenia stolterfothii H. Pèr.	Madras coast	Menon (1931)
	Trivandrum coast	Menon (1945)
	Madras coast	Subrahmanyan (1946)
	Around Krusadai Island	Chacko (1950)
R. robusta Norman	Madras coast	Menon (1931)
	Trivandrum coast	Menon (1945)
	Madras coast	Subrahmanyan (1946)
R. imbricata Brightwell	Madras coast	Subrahmanyan (1946)
	Around Krusadai Island	Chacko (1950)
R. styliformis Brightwell	Madras coast	Subrahmanyan (1946)
	Around Krusadai Island	Chacko (1950)
R. setigera Brightwell	Madras coast	Menon (1931)
	Trivandrum coast	Menon (1945)
	Madras coast	Subrahmanyan (1946)
	Around Krusadai Island	Chacko (1950)
R. calcar-avis M. Schultze	Madras coast	Menon (1931)
	Trivandrum coast	Menon (1945)
	Around Krusadai Island	Chacko (1950)
R. alata Brightwell	Madras coast	Menon (1931)
	Trivandrum coast	Menon (1945)
	Madras coast	Subrahmanyan (1946)
	Around Krusadai Island	Chacko (1950)
Bacteriastrum hyalinum Lauder.	Madras coast	Subrahmanyan (1946)
Chaetoceros eibenii Grunow	Madras coast	Subrahmanyan (1946)
C. peruvianus Brightwell	Madras coast	Subrahmanyan (1946)
	Around Krusadai Island	Chacko (1950)
C. lorenzianus Grunow	Madras coast	Subrahmanyan (1946)
	Around Krusadai Island	Chacko (1950)
C. compressus Lauder	Madras coast	Subrahmanyan (1946)
C. affinis Lauder	Madras coast	Subrahmanyan (1946)
	Around Krusadai Island	Chacko (1950)
C. curvisetus Cleve	Madras coast	Subrahmanyan (1946)
Ditylum sol Grunow	Madras coast	Subrahmanyan (1946)
	Around Krusadai Island	Chacko (1950)

Species of diatoms	Places of occurrence	Author and year o description
Biddulphia sinensis Greville ...	Malabar coast	Hornell and Nayudu (1924)
	Madras coast	Menon (1931)
	Trivandrum coast	Menon (1945)
	Madras coast	Subrahmanyan (1946)
	Around Krusadai Island	Chacko (1950)
B. mobiliensis Bailey ...	Malabar coast	Hornell and Nayudu (1924)
	Madras coast	Menon (1931)
	Trivandrum coast	Menon (1945)
	Madras coast	Subrahmanyan (1946)
	Around Krusadai Island	Chacko (1950)
Thalassionema nitzschioides Grunow ...	Madras coast	Menon (1931)
	Trivandrum coast	Menon (1945)
	Madras coast	Subrahmanyan (1946)
	Around Krusadai Island	Chacko (1950)
Thalassiothrix longissima Cleve and Grunow ...	Madras coast	Subrahmanyan (1946)
	Around Krusadai Island	Chacko (1950)
T. frauenfeldii Grunow ...	Trivandrum coast	Menon (1945)
	Madras coast	Subrahmanyan (1946)
	Around Krusadai Island	Chacko (1950)
Asterionella japonica Cleve ...	Malabar coast	Hornell and Nayudu (1924)
	Madras coast	Menon (1931)
	Trivandrum coast	Menon (1945)
	Madras coast	Subrahmanyan (1946)
	Around Krusadai Island	Chacko (1950)
	Cooum river mouth	Iyengar and Venkataraman (1951)
Cocconeis placentula Ehr. var. *euglypta* (Ehr.) Cleve ...	Freshwater streams, ponds and pools of Madras	Venkataraman (1939)
	River Cooum	Iyengar and Venkataraman (1951)
Bacillaria paradoxa Gmelin ...	Madras coast	Menon (1931)
	Adyar estuary, Madras	Venkataraman (1939)
	Madras coast	Subrahmanyan (1946)
	Around Krusadai Island	Chacko (1950)
Nitzschia closterium (Ehr.) W. Smith. ...	Madras coast	Menon (1931)
	River Cooum, Madras	Venkataraman (1939)
	Trivandrum coast	Menon (1945)
	Madras coast	Subrahmanyan (1946)
	Around Krusadai Island	Chacko (1950)
N. longissima (Brebisson) Ralfs ...	Madras coast	Subrahmanyan (1946)
	Around Krusadai Island	Chacko (1950)

GROWTH-RATE OF THE PEARL OYSTER, *PINCTADA PINCTADA* IN THE GULF OF KUTCH WITH A NOTE ON THE PEARL FISHERY OF 1953[1]

BY

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(*With five text figures*)

CONTENTS

1. Introduction 124
2. Previous Work 125
3. Material and Methods 125
4. Age-Analysis 126
    (a) Growth-Rings 126
    (b) Period of Ring-Formation 127
    (c) Probable Causes 128
    (d) Growth-Rate 129
    (e) Agreement with Petersen's Method 130
5. Population Study (Analysis of the Stock) 131
6. Summary 135
7. Acknowledgments 135
8. References 136
9. Addendum 136

INTRODUCTION

Pearl Oysters are commonly found off the Northern Coast of the Halar District (Saurashtra) in the Gulf of Kutch. The species has been recorded in the Directorate of Marine Products, Saurashtra as *Pinctada pinctada* and for the sake of convenience it has been referred to by the same name in this paper but this identification is not final yet. These oysters are found attached to coral reefs (known locally as 'kadda') of which 42 have been charted off the Halar Coast. Some of the important reefs are shown in the accompanying map. These reefs are situated in the inter-tidal zones and get completely exposed during the low tides. Collection of these oysters is, therefore, a comparatively simple operation and does not entail any diving, etc. Pearls have been obtained fairly regularly from these waters for the last two hundred years at least and are well-known for their lustre and brilliance. We are not aware of any systematic work that has been carried out on the bionomics of these oysters in the Gulf of Kutch. It was decided to undertake the study of its growth-rate and find out the approximate age at which the pearl-formation starts, for which purpose a Pearl Oyster Research Scheme was sanctioned by the Government of Saurashtra. Such studies have both commercial as well as scientific importance which cannot be over-emphasized.

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[1] Communicated by Mr. K. R. Srivatsa, the Director of Marine Products, Government of Saurashtra.

The investigations described here were conducted under the Pearl Oyster Research Scheme of the Government of Saurashtra.

Previous Work

In his paper on *K. apima*, Rao (1951) has surveyed some of the work that has been carried out on the bivalve molluscs in the tropical seas. According to him, Herdman (1903) and Malpas (1933) have studied the growth-rate of the Ceylon Pearl Oyster, *Pinctada vulgaris*. Hornell (1922) and Cahn (1949) are other workers not mentioned by Rao. Hornell studied the growth-rate of the Ceylon Pearl Oyster while Cahn has traced the entire life-history of the Japanese Pearl Oyster, *Pinctada martensii.* None of these authors mention the use of annular growth-rings in their studies. Rao (1951) has himself used such rings for ascertaining the age of *K. apima* and has shown that his readings agree with the length-frequency measurements. According to him the rings are 'disturbance rings' caused by the cessation of growth which, in itself, may be due to a drop in the salinity of the sea-water. He finds sufficient regularity in the occurrence of these 'disturbance rings' to justify assumption that they indicate the approximate age of the animal. Growth-rings are known to occur annually in the skeletal structures of fishes and on the shells of bivalves such as *Pecten sp.*, etc. in the temperate seas. From our observations on the pearl oysters kept in cages at Sikka from 1951 we found that such rings are formed annually on their shells and hence we have used them in our studies.

Material and Methods

Other material for these investigations was collected mainly from the pearl fishery of 1953. It was not possible to examine each and every oyster fished during this period and we had to content ourselves with random samples taken from this stock. Under the existing regulations the fishermen employed for collection could not bring in oysters below a certain size-limit. Consequently the stock fished was itself bias towards the older animals and this was also reflected in the random samples obtained by us. We were unable to get specimens of age-groups '0' and '1'. Even the number of animals belonging to age-group 2 was very small making it difficult to calculate the average size of that group accurately. On the other hand, seven-year old animals, though not affected by this selection were a few in number while only three eight-year animals were obtained. The total number of oysters fished during the Pearl fishery of 1953 was 11,519 of which 1,353 constituted the random samples and were examined in detail. Apart from these, 334 oysters kept in cages in the Pearl Oyster Park at Sikka were measured regularly every month for a period of two years and formed the main source for observing the formation of 'growth-rings'.

In the beginning three different types of linear measurements were recorded—the length, the depth and the thickness. The lines of these measurements are shown in Fig. 1. It was, however, soon apparent that the thickness gave more consistent data than the rest and hence in later studies only the thickness was measured. This incidentally made it possible to measure a large number of animals.

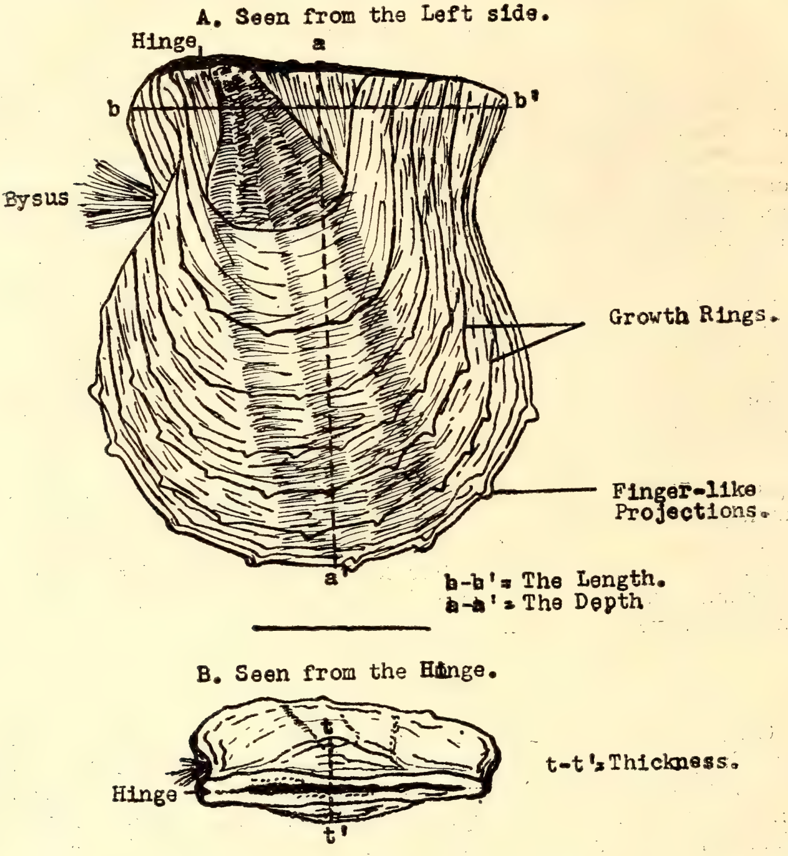

A. Seen from the Left side.
Hinge
a
b
b'
Bysus
Growth Rings.
Finger-like Projections.
a'
b-b' = The Length.
a-a' = The Depth
B. Seen from the Hinge.
t
t-t' = Thickness.
Hinge
t'

Fig. I
Diagrammatic Sketch of *P. pinctada*

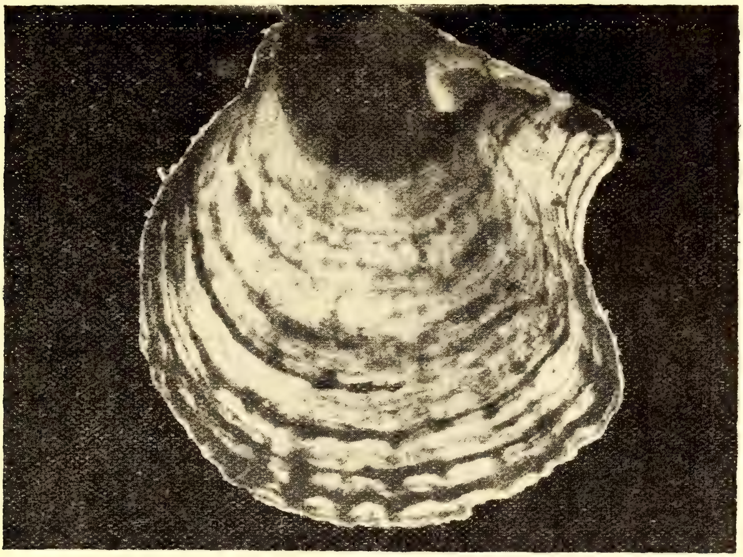
Thickness can be defined as the maximum distance between the external surfaces of the two valves of the oyster. These measurements could easily be made with a pair of callipers and were recorded to the nearest millimeter. The number of 'rings' on the valves were also observed and recorded against the particular individual for correlation studies.

AGE-ANALYSIS

(a) Growth-rings:

Fig. II shows a photograph of the right valve of an oyster five years old. There are a number of concentric rings on the valve but out of them five are seen better marked than the rest. These are referred to in the following pages as 'growth-rings' or merely as 'rings'. The formation of these rings appears to be as follows:—

Towards the free edge of a young oyster are always seen small finger-like projections. These are particularly better marked during winter when the growth is quite fast. During summer when the growth slows down these projections disappear and instead there appears a continuous line—the growth-ring. Later on fresh projections appear which will give rise to the next year's ring. A real ring is one which is continuous from the anterior to the posterior end and is much deeper than the rest. The rings are better seen on the deeper left valve than the right but it is safer to see carefully both the valves before coming to any conclusion. In case of doubt the valves may be separated and each seen silhouetted against the sunlight when the true rings appear very clear. Even so the differentiation of true rings from the 'false' rings is difficult and it is only after some experience that it becomes possible to identify the age correctly. About 5% of the oysters had to be discarded because no proper differentiation of the lines could be made.



[*Photo by Jamnagar Photo Co.*

FIG. II

Photograph of the right valve of a five-year old *P. pinctada* silhouetted against powerful artificial light. The black portion towards the straight margin is the point of maximum thickness. (Reduced to five-eighth of the original size.)

(b) Period of ring-formation:

That these rings are annual features (formed once in a year) and represent a year's growth was proved by our observations on the oysters kept in cages at Sikka. It was found that in a majority of cases the rings were formed during the summer months when the growth ceased. It was also ascertained from these records that these rings were permanent features and once formed never diminished in size.

To avoid any mistake occurring through the subconscious each oyster in our Park was given a serial number and its rings were counted every month without referring to the previous records. So far only four oysters have been found incorrectly read. This in itself is a proof that the method is quite valid and reliable in the age-analysis of these oysters.

(c) Probable Causes:

As regards the causative factors of the periodic growth of the oysters and the formation of the rings, nothing can be said with certainty. Cahn (1949) finds two distinct periods each year—one of faster growth and the other of comparative rest—in the Japanese oyster and attributes the slower rate chiefly to the drop in the sea-temperature during December to April when oysters hibernate. Fig. III shows the mean sea-temperatures (taken near the bottom) at the Pearl Oyster Park at Sikka. Also shown on the graph are the periods of active growth and rest as observed at Sikka. It will be seen from this data that the oysters in the Gulf of Kutch grow vigorously between November and February when the temperature of the sea varies between 23°C. and 27°C. while during the summer months, when the temperature is higher, the growth ceases. However the difference between the summer and winter temperatures is not so high as to justify the assumption that this physical factor is mainly responsible for the cessation of the growth; especially so, when one considers that these temperatures represent only the means. In day-to-day temperatures there was too much of variation and even over-

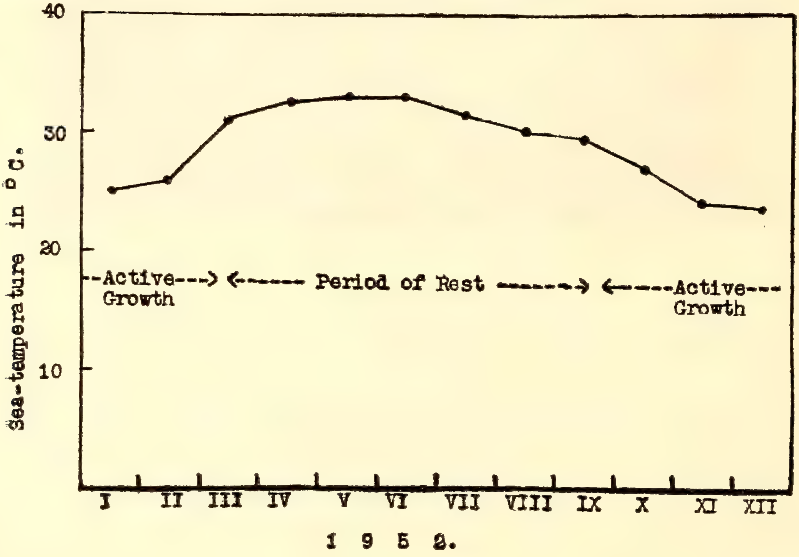


Fig. III

Mean Sea-temperatures from the Pearl Oyster Park at Sikka lapping. Rao (1951) finds that growth in *K. apima* seems to be arrested during August to December when there is a fall in salinity of the sea-water. Salinity in the Gulf of Kutch does not show appreciable fluctuations and we have no evidence to presume that it has anything to do with the retardation of growth. Cessation of growth due to metabolic strains such as caused by low feeding or spawning is known to occur amongst some of the marine fishes particularly those of the temperate seas. Enough data on the biology of these oysters are not yet available and hence it would be too premature to comment on these factors but it is likely that they are more likely causes of the cessation of the growth amongst the oysters than the sea-temperature.

(d) Growth-rate:

In studies on age-analysis with the help of annual rings it is very essential to know the approximate age of the individual at the time when the first ring is laid down. Since we do not know the exact extent of the spawning season of *P. pinctada* nor do we have enough specimens of age-groups 'o' and '1', we are not in a position to say when the first ring is laid down and consequently our readings are likely to be wrong by six months on either side. Thus when we say that the oyster is 4 years old, it may be anything between 3 years 6 months and 4 years 6 months.

As stated previously the thickness was correlated with the rings and the data thus obtained is shown in table 1. The average thickness (weighted means) of oysters at various ages calculated from this data are given below:—

Age	*Thickness in mm.*
2	21·8
3	25·0
4	29·2
5	32·7
6	35·4
7	37·2 (?)

The number of two-year old animals is very small in table 1 and hence their average may not be correct. Moreover, oysters lesser than 15 mm. thick were not collected. If these could have been included in this data, the average thickness of that age group would have gone down. Similarly, only 19 specimens of age group 7 were obtained and the average thickness may, therefore, not be reliable. This data shows that the oyster grows quite fast till its fourth year but after that age the growth-rate slows down. These findings are similar to those of Hornell (1922) who observes that 'the growth of the Indian oyster is distinctly retarded after the third year'. We, however, feel that this slowing down of the growth-rate is not so much due to the 'abundance of encrusting organisms' suggested by Hornell as due to a drop in the general metabolism with the advancing age. Marine fishes are known to grow fast till they attain sexual maturity after which their growth-rate falls. It is likely that the pearl oyster reaches sexual maturity towards its 3rd or 4th year which may explain the drop in the growth-rate after that age.

The life-span of *P. pinctada* in the Gulf of Kutch seems to be seven years though a few individuals survive to the eighth year. According to Hornell (1922) the pearl oyster in the Gulf of Manaar lives to about five years of age, while according to Cahn (1949) *P. martensii* lives to about eight years. Hornell has not given any basis of his age-assessment but Cahn has summarised the studies of Mr. M. Yanagonchi of the Japan Institute of Scientific Research on Pearls. Mr. Yanagonchi has traced the entire developmental history of *P. martensii* and hence his findings are more reliable than those of Hornell. Comparing Cahn's data with ours it seems that there is not much difference between the life-spans of *P. pinctada* and *P. martensii.*

TABLE 1

Correlation between the thickness and the age of *P. pinctada*.

Thickness in mm.	2 yrs.	3 yrs.	4 yrs.	5 yrs.	6 yrs.	7 yrs.	Total
18	1	—	—	—	—	—	1
19	4	—	—	—	—	—	4
20	13	4	—	—	—	—	17
21	14	9	1	—	—	—	24
22	12	14	—	—	—	—	26
23	11	28	4	2	—	—	45
24	8	52	6	4	—	—	70
25	4	66	18	5	1	—	94
26	1	53	33	2	1	—	90
27	—	30	50	5	1	—	86
28	—	13	58	4	1	—	76
29	—	10	97	13	2	—	122
30	—	2	124	42	5	—	173
31	—	1	42	56	2	—	101
32	—	—	31	67	3	—	101
33	—	—	10	35	7	2	54
34	—	—	8	62	7	2	79
35	—	—	13	57	18	2	90
36	—	—	2	14	21	3	40
37	—	—	2	6	8	2	18
38	—	—	1	7	3	2	13
39	—	—	—	2	2	1	5
40	—	—	—	—	7	1	8
41	—	—	—	—	5	2	7
42	—	—	—	—	3	2	5
43	—	—	—	—	2	—	2
44	—	—	—	—	2	—	2
Total ...	68	282	500	383	101	19	1 353

(e) Agreement with Petersen's Method:

Petersen's method essentially consists in measuring a very large number of individuals of a species and finding out the 'peaks' or the 'modes' which represent various age-groups. This method gives good results particularly for the young growing animals when the growth-rate is quite fast and distinct modes are seen; but with the advancing age the growth-rate falls and very often Petersen's curve does not show any peak at all.

In fig. IV is shown a histogram of the thickness-frequencies of the pearl oyster. Superimposed on this are the lines indicating the average thicknesses of various age-groups as deduced from the rings. Except for the age-group 7 there is a fairly good agreement between the peaks of Petersen's method and the thickness claculated from the rings. The number of seven-year old animals was small which may be responsible for the disagreement. Moreover, as stated earlier the growth-rate at this age falls considerably and consequently Petersen's method cannot be solely relied upon; but the agreement which exists amongst other age-groups is ample proof of the reliability of the method of age-analysis with the help of annular rings.

POPULATION STUDY (ANALYSIS OF THE STOCK)

A total of 11,519 oysters were fished during the Pearl Fishery 1953. During the pearl fishery of 1950 we had obtained 33,720 oysters and on an average about 17,000 oysters have been fished in each of the previous fisheries since 1913. The drop in the output this year is primarily due to shortage of fishermen who volunteered for the fishery. *Per capita* production, however, has remained the same.

When random samples were studied from this stock, some interesting information was obtained and which is summarized below:—

(i) The stock is a normal population. The various year-broods were represented as follows:—

1951 brood	5%
1950 brood	21%
1949 brood	37%
1948 brood	28%
1947 brood	8%
1946 brood	1%

These figures are represented in histogram in figure V. The population does not show any signs of over-fishing. The fact that 1950 brood forms about one-fifth of the stock and that the 1949 and 1948 broods form the bulk of the population today, prove that fishing conducted during 1950 was restricted to the older animals only and that too perhaps after spawning. A proper survey of animals belonging to 1951 brood will give a definite answer to this problem, but that two of us (C.R.E. and R.N.) collected twenty-five such animals within a search of two hours lends supports to this belief.

(ii) Growth-rate of the oysters was not the same on all the beds. Amongst the oysters collected from Movada and Deda, a majority were older oysters and even the rate was faster. Movada also provided the youngsters mentioned above. It is likely that these beds have probably the optimum conditions for the growth and propagation of the pearl oysters.

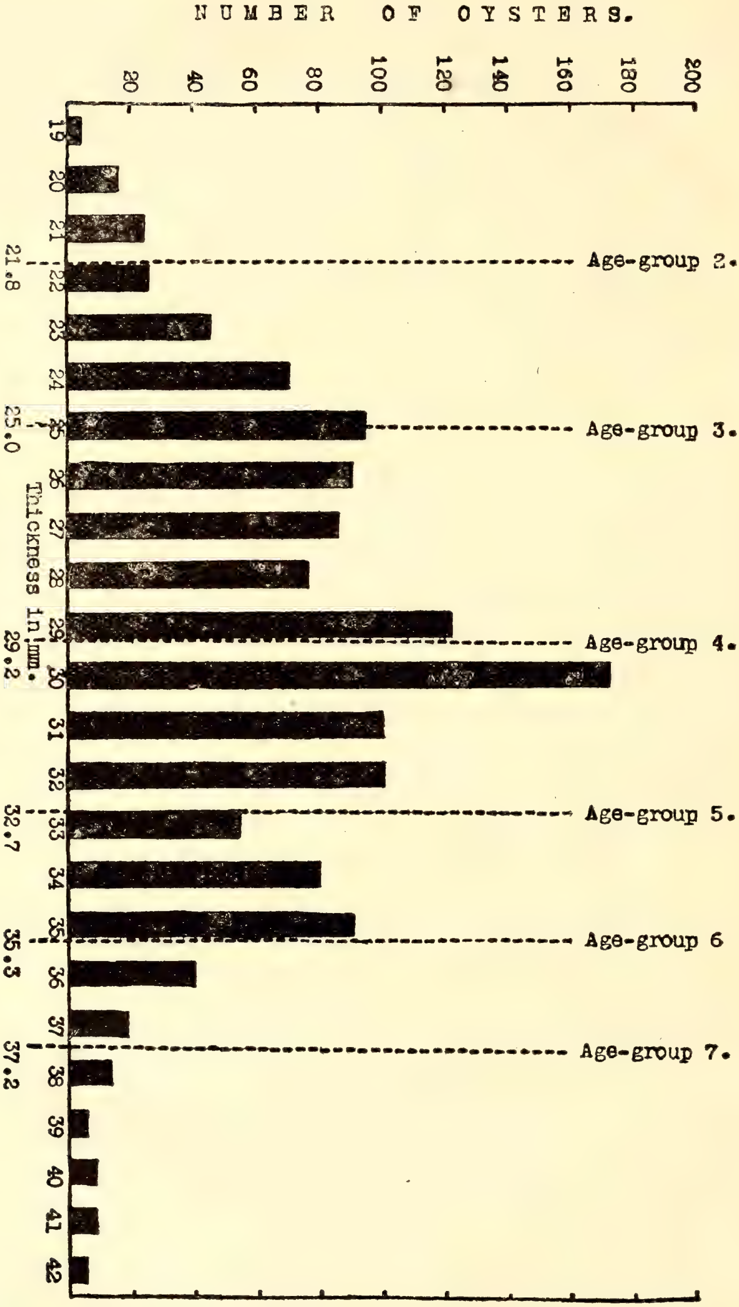


Fig. IV

Histogram showing the frequency of thickness

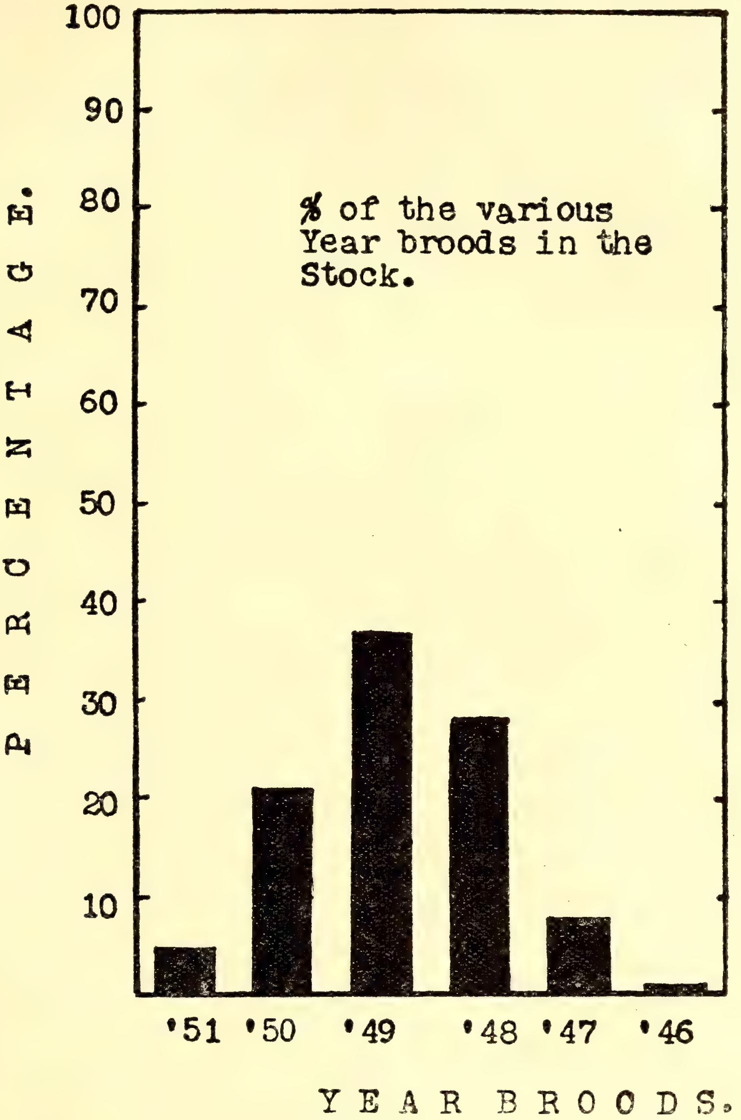


Fig. V

(iii) When the growth-rate of these 'wild' oysters (i.e. collected during the pearl fishery) was compared with that of oysters kept in cages at the Sikka Park, it was found that the latter showed a distinct retardation of growth after the third year. Since the number measured in the Sikka Park is rather small (334) we do not commit ourselves on this point but there is an indication that the growth in the Park is not very satisfactory. At present we are keeping the oysters in cages with wire meshes on one side and wood on the other three. Obviously these are not suitable for healthy growth.

Perhaps bamboo-fence enclosing a few acres of the oyster bed will serve the purpose better, although this will be more expensive.

(iv) On an average 15 to 20% oysters bear pearls. Narada bed differed in this respect in that about 30% oysters had pearls in them. Even the quality of the pearls produced in this bed was decidedly better. This is borne out by the fact that the total number of oysters collected from this bed in the sample survey was only 741 while the value of pearls was Rs. 2,380, a much higher average than that usually obtained.

(v) When the pearl bearing oysters were classified into their respective age-groups, the following data was obtained:—

Age-group	Number of oysters	Percentage
2	3	—
3	35	16·9%
4	68	32·8%
5	76	36·7%
6	25	23·6%
7	4	—

It appears from this data that the optimum conditions for the formation of pearls exist in the oyster when it is between three and six years old. Pearl formation starts at the age of three and rarely at two. It has already been shown that six-year old animals form only 8% of the stock. Looking from this point of view it seems that chances of pearl formation are more in 6-year old animals than in other age-groups. Cahn (1949) points out that three-year old animals are chosen for inserting the nucleus in the oyster for cultured pearls in Japan and that the harvesting age is between 6 and 7. Our data also points in the same direction and culture experiments, if and when started, should be attempted when the oysters are three years old.

A point worth considering in this respect is whether the present system of conducting pearl fisheries every third year is scientifically correct. From the above data it would appear that conducting a fishery every fourth or even fifth year should be more beneficial than in the third. There is, of course, the danger of losing the older oysters altogether but if fishing is done intensively and the old oysters removed this difficulty can be overcome. Moreover, the number of 6- and 7-year old animals is small and they can be removed by the departmental staff during their inspection tours.

(vi) Majority of the pearls were found near about the adductor muscle, mostly towards the hinge. We could not give proper attention to the study of location of pearls, etc., but mostly they were muscle pearls and smaller cyst pearls as defined by Hornell (1922).

Usually the muscle pearls appeared in clusters. Most of the pearl-bearing oysters contained more than three or four pearls each. It was exceptional to find only one pearl in an oyster. The highest number of pearls so far recorded from a single oyster is 68. Fusion of two or more pearls to form a bunch was not uncommon. It may be mentioned here that pearls of high values have been obtained from these waters. During the pearl fishery of 1950 one pearl was valued at Rs. 1,000 while the records show that during 1943-44 one pearl valued at Rs. 12,000 was collected from an oyster from the Narada Bed.

SUMMARY

(i) The growth-rate of the adult pearl oyster, *Pinctada pinctada* in the Gulf of Kutch has been worked out with the help of annual rings. As the samples were bias, the growth-rate of two-year old and younger animals could not be calculated.

(ii) Two distinct periods—one of active growth and the other of rest—were observed in a year but no cause could be traced. It is likely that some internal biological factor is responsible for this cessation of growth.

(iii) It has been shown that the oysters grow fast till they attain their fourth year after which the growth rate falls. It has been presumed from this that the animal reaches sexual maturity at the age of three or four.

(iv) Life-span of these oysters seems to be seven years, though a few survive to the eighth.

(v) From sample-surveys of the pearl fishery in 1953 it has been ascertained that there are no signs of overfishing. On the contrary there is every reason to believe that this year the beds have been much underexploited due to labour shortage.

(vi) On an average 15 to 20% oysters bear pearls. Amongst the pearl-bearing oysters, age-groups of 4, 5, and 6 years predominate. It is likely that the pearl formation starts when the oyster is 2-3 years old. It has been suggested that conducting the fishery every fourth year would be more beneficial.

ACKNOWLEDGMENTS

The authors wish to express their gratitude to Sri. K. R. Srivatsa, the Director of Marine Products, Saurashtra, for offering all the help and for suggesting these investigations. They are also indebted to Dr. S. L. Hora of the Zoological Survey of India for kindly going through the manuscript. They are grateful to Sri. K. V. Rao of the Central Marine Fisheries Research Station, Mandapam, for favouring us with a reprint of his paper on *K. apima.* Sincere thanks are also due to the members of this Directorate, especially Sri. N. C. Lakumb and Sri. M. T. Nathan for their help in the collection of data.

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ADDENDUM

During discussion on the growth-rate of Pearl Oysters with Shri K. Chidambaram, Assistant Fisheries Development Advisor to the Government of India in February 1954 he referred to the attempts of the Madras Fisheries Department to study bionomics of the pearl oyster of the Gulf of Mannar. An unpublished report on these studies extending over a period of nine years by D. W. Devanesan and K. Chidambaram (1950) was made available to us. These workers reared spats of known age and correlated age of oysters with body or thickness at the hinge as factors in age and growth assessment. The extensive investigations carried on by them for prolonged period, if reported and published would be valuable to workers on Bionomics of Molluscs.

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* Papers are not seen by us.

CRITICAL NOTES ON THE IDENTITY AND NOMENCLATURE OF SOME BOMBAY PLANTS

III. *MURDANNIA SCAPIFLORUM* (ROXB.) ROYLE.

BY

R. FERNANDES, B.SC.

AND

H. SANTAPAU, S.J.

(*With two plates*)

This paper is a continuation of several by the senior author (H.S.) published in this journal in the last few years. (See *J.B.N.H.S.* 50: 305-312; 428-430; etc.).

In our field work in the Krishnagiri National Park, Borivli, Salsette Island, we have found a plant that has given us plenty of trouble before we could come to a definite conclusion as to its identity. Finally after a detailed study of the pertinent literature on the subject, we have come to the conclusion that our plant is identical with the one listed by Cooke in his *Flora of the Presidency of Bombay* under the name *Aneilema scapiflorum* Wight. The main reasons for our difficulty in identifying the plant were that neither Wight nor Clarke describe the root system of the plant, and Cooke only mentions that the roots possess 'pisiform' tubers; further the diagrams shown by Wight and Clarke picture a juvenile specimen, and their descriptions refer to the same undeveloped plant; the picture given by Royle has not been seen.

We shall give here a complete description from numerous specimens collected in the field; we have found this plant on several occasions and in large numbers, so that we have had ample opportunity to examine the development of the specimens at leisure.

1. The generic name Murdannia Royle.

Our plant is placed under the generic name *Aneilema* R. Br. in Cooke's Flora, and in this he follows Hooker in the *Flora of British India*; most authors of local or provincial floras of India follow suit and use the name *Aneilema*. Royle in 1839 gave the name *Murdannia* to a section of the genus *Aneilema*; Brückner in 1926 named the same section *Phaeneilema*, which was made into an independent genus; but in 1930 the same Brückner recognised that his *Phaeneilema* coincided entirely in its circumscription with *Murdannia* Royle. The name *Aneilema* R.Br. is a valid genus, but our Bombay plants do not belong to it; for our plants the oldest valid name is *Murdannia* Royle.

Brückner, in Engl. & Pr. Pflanzenfamilien (ed. 2) 15 A: 165, divides the family Commelinaceae into two subfamilies, on the following grounds:

A. Flowers actinomorphic ... *Tradescantieae*
B. Flowers zygomorphic ... *Commelineae*

The genus *Murdannia* belongs to the subfamily *Tradescantieae*, tribe *Triandrae*; on the other hand the genus *Aneilema* in the restricted sense belongs to the subfamily *Commelineae,* tribe *Declinatae*. Thus, although the name *Aneilema* R. Br. (1810) is much older than *Murdannia* Royle (1839), the latter name is considered valid as one of the subdivisions into which the conglomerate of species under *Aneilema* R. Br. has been split by Brückner.

2. The specific name.

Murdannia scapiflorum (Roxb.) Royle, Ill. Bot. Him. 403, t. 95, 1839; Brückner in Engl. & Pfamilien. (ed. 2) 15 A: 173, 1930.

Commelina scapiflora Roxb. Fl. Ind. 1: 175, 1832.

Aneilema scapiflorum Wight, Icon. 6: 30, t. 2073, 1853; Hook. f. in Fl. Brit. Ind. 6: 375; Clarke, Comm. Cyrt. Beng. 26, t. 14, 1874 & in DC. Mon. Phan. 3: 200, 1881; Cooke, Fl. Pres. Bombay 2: 786, 1906.

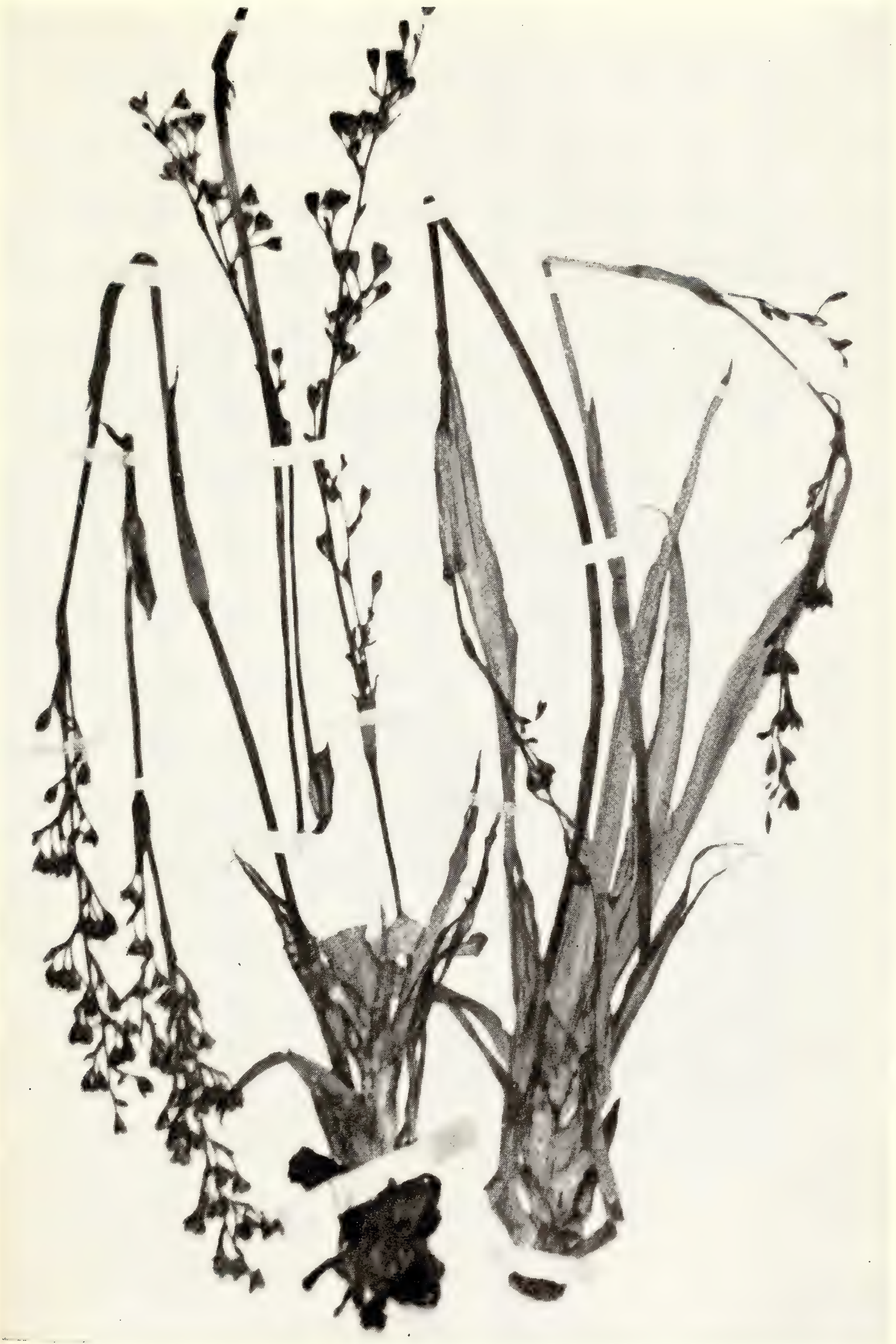
Aneilema tuberosum Ham. in Wall. Cat. 5207, nom. nud.

3. Previous descriptions of the plant.

The first description of this plant is that of Roxburgh in Flora Indica (Carey Ed.) 1: 175, 1832, where he writes: '*Root* perennial. *Racemes* radical, erect, with alternate, many-flowered spathes. *Petals* equal. *Leaves* in a tuft, ensiform. . . . *Root* perennial, composed of several, smooth, elongated tubers, with a few filiform radicles. *Stems* none, except the sheathing bases of the leaves which appear a month or two after the flowers; these are ensiform, waved, acute, smooth, and marked with several straight veins; length from four to eight inches, breadth one. *Racemes* radical, erect, straight, smooth, invested at each of the remote two or three joints, with a small, solitary sheath; these sheaths towards the top are more approximated, each of them there embracing the insertion of a branchlet which bears several pedicelled flowers. *Calyx* the three leaflets thereof broad-lanceolate, and considerably shorter than the corol. *Petals* equal, round, concave. *Nectaries* alternate with the stamens, hairy. *Filaments* three, alternate with the petals, longer than the filaments of the nectaries, and like them hairy about the middle. Anthers blue. *Pistil* declining. *Stigma* minutely three-toothed.'

Among the older authors who have described the plant, Roxburgh is the only one to mention the tuberous roots; such roots are not found in the figures of Wight or Clarke; the latter mentions, however, that 'Radix plus minus tuberosa unde nomen Hamiltonianum'. (The root is tuberous, hence the name given by Hamilton *Aneilema tuberosa* in Wall. Cat. 5207, 1831-1832; Hamilton's name happens to be the oldest for this plant, but being a *nomen nudum* in the sense of Art. 42 of the present Internat. Code of Bot. Nomencl. it is invalid, and must not be taken into consideration for the purposes of nomenclature.) The roots are missing from the type specimen by Wight in Kew Herbarium (see plate I).

We have examined the present plant in the living condition in the field, and have had the whole plant, the roots and tubers included, carefully lifted out of the ground; our description will differ in some



Murdannia scapiflorum Royle.
Photograph of Wight's Type sheet in Kew Herbarium.

particulars from those of Roxburgh, Clarke and Wight, all of whom seem to have dealt with more or less imperfect plants. This is perhaps why Wight, in Icon. 6: 30, gives the following warning note: 'My drawing is taken from a dried specimen with fruit, generally, nearly mature and does not therefore give a good idea of the flowering plant. Neither Roxburgh nor Royle mentions the fruit, though the latter constitutes this a new genus. Royle's figure does not much resemble mine, but the difference seems to depend on his being a younger and less luxuriant form. The open flower of my drawing is taken from an unopened one, and may not represent the correct proportions of the parts as seen in naturally opened ones, but if they do represent the correct proportions, it seems to me this can scarcely be Roxburgh's plant, as he distinctly mentions the petals being longer than the calyx. The inflorescence too seems different, that of mine being properly a panicle, while he calls his a raceme, but describes it as having "branchlets", this showing that it has the elements of a panicle, only wanting luxuriance to develop it, as shown in my plant.'

Clarke, in DC. Mon. Phan. 3: 201, describes the plant thus (the description translated from the Latin original): 'The root fasciculate with fusiform tubers. Leaves 10-15 cm. long, 1-1.5 cm. broad, somewhat narrowed at the base, scabrid. Scape 10-40 cm. tall; the bracts at the primary dichotomies 1-5 cm. long; higher bracts small, amplexicaul, ovate, truncate. Petals blue. The pedicels in fruit 1 cm. long, suberect. Stamens 3 perfect, 3 sterile, all the filaments bearded. Capsule trigonous-ellipsoid, mucronate and scarcely acute at the apex, lead-coloured. Seeds in each loculus 3-6, uniseriate, straw-coloured with a white aril, reticulate and scabrid with very minute dark glands, superposed exactly, forming a triangular column which is rounded at the back . . . India, at altitudes 0-1,000 meters . . . ; mostly in grass fields that have been burnt; fairly frequent.' It is clear from this description that Clarke was describing an immature or juvenile form of this species; the description agrees fairly well with the plants we have collected at the beginning of the season in Salsette.

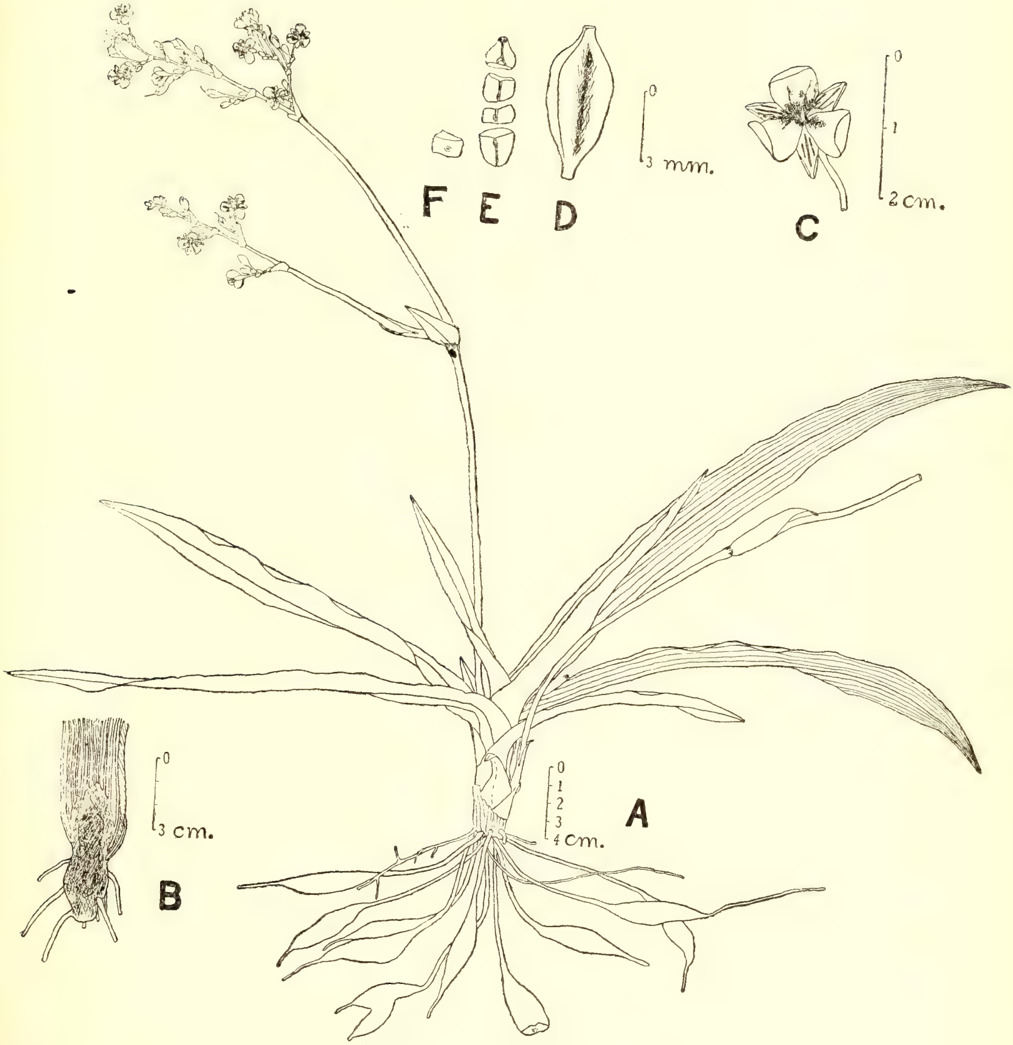
Cooke, on the other hand, speaks of 'Roots of elongate *pisiform* tubers. . . Leaves 4-8 × $\frac{3}{8}$-$\frac{5}{8}$ in. . . . Flowers in erect elongate panicles on *terminal* leafless scapes; scape together with the panicle 8-18 in. long . . .' (Italics ours). Obviously the word *pisiform* is a mistake for *fusiform* tubers; Cooke further mentions that the panicles are terminal; in none of our specimens have we found a single plant with terminal scapes; they are all lateral, one or two scapes for each plant, the scapes appearing either immediately before the leaves, or one scape before the leaves, the second one appearing in fact when the leaves are already fairly well developed.

4. Our own description of the plant.

We give now our own description, which is illustrated by a careful diagram of the whole plant and with some details about the flowers and fruits (see plate II).

A perennial *herb*; *root-fibres* rather stout, coming from the base of the stem, up to 40, usually 15-20, in number, about 3-4 mm. thick, straw-coloured outside, pure white inside, many of the roots having a fusiform or ellipsoidal tuber at their end or at some distance from it, that is to say, the root may continue for some distance beyond the tuber; tubers white inside, about 4 × 1 cm. in size, of the same colour as the fibrous roots. *Stems* short, hypogeal, about 2 cm. long or a little longer, and together with the bases of the leaves about 2 cm. diameter. *Leaves* all radical, up to 10 in number in our specimens, alternate, the middle ones the largest, upper and lower leaves gradually decreasing in size, the lower ones passing into large bracts or scales at the base; the leaves are up to 60 × 4.5 cm., usually about 40 × 4 cm., somewhat coriaceous, glabrous or nearly so, ensiform, parallel-veined, the nerves not being conspicuous; margins waved and with a narrow hyaline border at least in young leaves; the midrib depressed above, prominent beneath. *Scapes* one or two, always lateral, not terminal, up to 100 cm., usually 30-50 cm. long, simple below, branched above; flowers only on the upper third of the scape, paniculate; each scape is supported by a large bract or sheath, which may be entire or bifid at the very apex; bracts at the forking of the scape large, more or less triangular, acute or acuminate, the base embracing the scape; the size of the bracts decreases from below upwards, until towards the apex of the plant they are but a few mm. in length. *Flowers* blue or purplish-blue, about 1 cm. in diameter when fully opened, bracteolate and pedicelled; the pedicels elongate in fruit up to about 1 cm. long; the flowers are perfectly regular, bisexual, hypogynous. *Sepals* purplish-green, 7 × 3-4 mm., oblong or slightly tapering and rounded at the apex, persistent; nerves 3-5, distinct. *Petals* 9 × 6 mm., or slightly larger, obovate, easily caducous, free. *Stamens* 3 perfect, 3 sterile; fertile stamens opposite the sepals and alternating with the petals; filaments of the fertile stamens filiform on the upper half, broadened into a strap-shaped lower half; filaments of sterile stamens uniformly filiform; anthers purple, dorsifixed, opening by longitudinal slits; sterile stamens or staminodes alternating with and shorter than the fertile ones, their anthers X-shaped; both fertile and sterile stamens are bearded with moniliform hairs of the same colour as the corolla; in the case of the sterile filaments such hairs are confined to the lower third of the filament; with fertile stamens such hairs are found only at the point where the filament narrows from the broad base. *Gynoecium* tricarpellary, syncarpous, superior, 3-celled; placentae axile; style simple, terminal, a little shorter than the fertile stamens and of the same colour; stigma capitate, small. *Fruit* a loculicidal capsule, about 6 mm. long, 2.5-3 mm. broad in the middle, obovoid, somewhat trigonous, beaked with the remains of the style. *Seeds* about 4 in each cell, exactly superposed and uniseriate, more or less trigonous, the two inner faces being flat, the outer face rounded and marked with a minute circular depression, in the middle of which there is a prominent mucro or clypeus. Seeds externally reticulate with a brownish aril, the reticulations being very minute and perfectly hexagonal in shape.

Habitat: In more or less water-logged soil beneath the protection of trees, along the plains on the south side of river Dahisar; it is not a common plant, but wherever it occurs it does so in considerable



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Murdannia scapiflorum Royle.

numbers, in almost pure stands; occasionally a few grasses or sedges are mixed with these plants, but more often than not the plant grows in pure formations; perhaps the reason for this is that, at the time our plant was collected in flower or fruit, grasses were very far behind in development and many had not yet appeared above ground.

Flowers were seen before any leaves had appeared above ground on June 18, 1953 (*Fernandes* 1260); on June 21, 1953, flowers were fully developed and some had already gone into fruit, while the first leaves were still but 3-6 cm. long (*Fernandes* 1276; *Santapau* 15627). By the 27 June, 1953, the leaves were up to 15 × 4 cm. and flowers about equalled the fruits in number, but only one scape for each plant was noticed up to that date (*Fernandes* 1311-1313). On July 4th many plants were collected with 2 scapes each, mostly in fruit; leaves were then about 30 × 3.5-4 cm. (*Fernandes* 1316; *Santapau* 15642-15643). On July 10, 1953, leaves were 40 × 4 cm., the scapes 50-60 cm. or even exceptionally larger (*Fernandes* 1335 A-C; *Santapau* 15653-15659). Finally on July 25th, 1953, we found plants with very large leaves, and only the remains of the inflorescence or the dehisced fruits. Comparison between young and old plants has further shown that the number of tuberous roots increases with the age of the plant; younger specimens showed 5-10 roots, while at the end of the fruiting season it was common to find up to 40 roots for each plant.

All the specimens mentioned in these pages are preserved in Blatter Herbarium, St. Xavier's College, Bombay.

EXPLANATION OF PLATES

PLATE I.—Photograph of Wight's type specimen in Kew Herbarium. Photo by H. Santapau, reproduced by kind permission of the Director, Royal Botanic Gardens, Kew.

PLATE II.—Diagrammatic representation of *Murdannia scapiflorum* Royle drawn by R. Fernandes.

A. Full plant.
B. Stem and base of leaves.
C. Flower.
D. Fruit, external view.
E. Seeds from a single cell seen from the inner angle.
F. Seed as seen from the outer side.

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THE DEVELOPMENT OF CEYLON'S FISHING INDUSTRY

BY

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INTRODUCTION

Ceylon, with a population of 6.7 millions in 1946, had just over 100,000 persons engaged in the fishing industry, or 1.7% of the population. It is an interesting fact that the 1921 Census showed that out of a population of nearly 5 millions, just under 80,000 persons were engaged in the industry, also 1.7% of the population. Of those at present engaged in the industry, it is estimated that about 72,000 fishermen are actively engaged in sea fisheries, and just under 9,500 in inland fisheries.

The annual production of fish is estimated at 90 million lbs. In other words, the average fisherman lands about 1,500 lbs. of fish each year. Compared with the production of Denmark, where the average is 33,000 lbs. per head per year (5), this is very low. In 1952, Ceylon's fish imports were valued at 55 million rupees (17), representing about 90 million lbs. of cured and preserved fish. If it were possible for the local industry to double its present production, the country will have gone a long way towards achieving self-sufficiency in fish. How is this target to be achieved?

It is clear that the industry is operating at a low level of efficiency. Primitive craft, the absence of capital for investment by fishermen, social prejudices, and the lack of new ideas or the incentive to progress have worked together to keep the industry in the role of a Cinderella. Little progress in comparison with that achieved in agriculture has blessed the fishermen's lot. An earlier awakening of public consciousness of the deplorable conditions under which fishermen lived and worked (2) was largely overshadowed by the international situation resulting from World War II, and almost the only significant progress achieved during that decade was the revival of trawler fishing operations, which showed that, in spite of the high cost of production, a trawler could be expected to bring in about two million pounds of fish per year at a cost of about 50 cents a pound, and that local personnel could be found or trained to man the trawlers (3).

Much expert opinion has been and is being sought on the problems of developing the island's fishery potential, and this has yielded, and is yielding, much valuable data, from which future operations will benefit very considerably (4-9). The Government first secured the services of a Danish team consisting of a Senior biologist, a fisherman and a fish-food technologist for two months; since then, the Fisheries Division of the Food and Agriculture Organisation through the Indo-Pacific Fisheries Council and the Extended Technical Assistance

Programme, and more recently the Colombo Plan Technical Assistance Bureau, have provided personnel and equipment for the investigation of the Island's fishery problems. Their energies have been directed to the introduction of more effective capture operations, cultural operations, and secondary industrial development for the provision of storage, transport, processing and handling facilities, to ensure that fish reaches the consumer in the optimum condition (17).

Problems of Fisheries Development

The development of the sea fisheries presents a complex problem. The present low level of production is partly the result of the use of primitive craft, with little inboard accommodation, and partly the result of vagaries in the availability of fishable stocks. As these craft are dependent on the wind, the fishermen are obliged to spend very little time in actual fishing operations, up to 4/5th of their time being spent on the daily voyage to and from the fishing grounds. The limited inboard accommodation permits the use of very restricted quantities of gear. The resultant income is very low, and the fishermen can barely earn sufficient to buy improved gear in more appropriate quantity, much less indeed buy mechanized craft. The Government has sought to rescue the industry from this plight by financing Co-operaive Societies of fishermen, either as Producer Societies for the purchase of craft and gear, or as Credit and Sales Societies to enable them to secure for the primary producer as large as possible a proportion of the ultimate value paid by the consumer, by eliminating the many existing links in the chain between producer and consumer. About 5% of the fishermen have so far formed themselves into Co-operative Societies, notwithstanding the great deal of impetus which the Government has endeavoured to give the project. A possible inference from this experience is that the Co-operative Society is not ideally suited to meet the requirements of the fisherman (8). On the other hand, it may not be the Co-operative system, but rather the inflexible procedure which is attendant on a Government controlled organisation that is responsible for the small number of Fishing Co-operatives. A possible solution lies in the inauguration of a National Fishing Corporation, the legislation for the operation of which is now being finalised.

Mechanization

The first impact of mechanization on the indigenous fishing industry in the Island came in 1949 when local fishing craft were towed out to well-known fishing grounds, which lay at some distance from the shore, and towed back to their base by an attendant mechanized craft (5). This enabled the fishermen to spend more time in actual fishing, and they made catches four or five times as large as was their wont. In certain districts, particularly in the northern half of the Island, there has been considerable interest shown in this type of operation. This is understandable, for the continental shelf is much wider in that region, whereas in the southern half of the island, the shelf only averages from 6 to 12 miles in width. Fishermen have, however, shown some reluctance to meet the entire cost of the operation of the attendant 'mother ships', although they have had indisputably better incomes during towing operations, and there have been many difficulties in operating mother ships, the chief being the lack of suitable harbours or moorings in fishing centres for craft of this type.

While this phase was in operation, six small mechanized fishing boats three of 22 ft. and three of 20 ft. were purchased from Denmark on the advice of the F.A.O. Fishery Engineer. These were put on fishing operations with locally trained fishermen, and have shown that they are capable of bringing in considerably larger catches than local craft. These boats are powered by a simple semi-diesel, hot-bulb engine, and fitted with an auxiliary sail, and can be beached where the surf is not heavy. The capabilities of these boats are being demonstrated now to Co-operative Fishing Societies, and it is anticipated that a request to finance the purchase of similar craft will be forthcoming from these Societies (19).

A further development has been the inboard mechanization of one type of local craft, which is the only fishing vessel type that is capable of accommodating an engine. The F.A.O. Fishery Engineer has installed three small marine diesel engines, which were supplied by the F.A.O., in these craft, and the Co-operative Societies which are using these boats have found that they are able to get to the fishing grounds earlier, spend more time in capture operations, and get back in time to catch the market at its peak. Earning capacity has been trebled. Great interest has been aroused in this venture. Already fifteen other boats have been equipped by the fishermen with marine engines, and a further twenty engines are on order. It is proposed that suitable engines should be imported, and that hulls should be built locally (in an endeavour to rejuvenate the local boat-building industry which has seen better days), in order that more mechanized boats may be available to meet the demand. The above remarks apply to the northern regions of the Island, where the local fishing craft are suitable for inboard mechanization. The sleek, swift, outrigger canoe of the southern seaboard is regarded as having reached the limit of its development, and, in its class, it has no equal for seaworthiness, speed, and ability to land on surf-lashed beaches. Experiments with the use of an outboard motor on these craft have given flattering indications, but the outboard motor is still regarded as a fickle and delicate piece of machinery, which perhaps will not give maximum efficiency with the heavy surf in which these craft are launched and beached.

The Colombo Plan

The most recent development has been the Canadian sponsored Colombo Plan project, under which two multi-purpose Canadian West-Coast type fishing vessels, built in Vancouver, are operating, each under the command of 2 Canadian fishermen, assisted by local crews. One of the boats specializes in the capture of surface types of fish, by trolling, ring-netting, gill-netting, and purse-seining while the other specializes in trawling, long-lining and demersal operations. These vessels have completed three months of exploratory fishing and will now engage in training local fishermen in the use of mechanized capture techniques. The trainees are to be drawn from Co-operative Fishing Societies, and will be financed to purchase suitable small boats and appropriate gear with which they will continue to fish on the lines of the training they have received. The hulls for these 20-30 ft. craft will be made locally; the engines will be imported for installation here. It is hoped that some of these trainees will be sent for further training in Canada under the Colombo Plan.

A part of the Canadian Aid has taken the form of a deep sea trawler, the 'Maple Leaf' equipped with a refrigerated fish-hold, which, with the Government trawler 'Braconglen' purchased in 1950 to replace the old trawler 'Raglan Castle', now makes a valuable contribution towards the island's fish supply. These trawlers fish on the Wadge Bank, some 4,500 sq. miles of trawling ground lying 150 miles to the west of Colombo (1), (3). Their catches vary from 70,000 to 140,000 lbs. for a 10- to 12-day trip, and, as they harvest a resource which is not normally drawn upon by indigenous fishermen, and on which no other regular fishery of any magnitude is based, their operations are being followed with a great deal of interest. Catches are now being studied in an effort to determine the productivity of the grounds and to detect any indications of depletionary tendencies in the fishery. A great extent of trawlable ground lies within commercially exploitable range of the Island, and this first successful tropical trawler fishery, which has now gone on for over 8 years without any sign of depletion, must undoubtedly be of great significance at the present time, when countries are turning their eyes towards the sea in their search for new sources of food for the people.

Shore Facilities

The shore facilities which exist today will not be adequate either to service an increased number of mechanized craft, or to deal effectively with the distribution of the increased landings. As a first step towards the provision of improved facilities for fish handling, the Government is constructing four ice-making plants, three five-ton and one ten-ton, in important producer areas, each equipped with refrigerated ice-storage and fish-storage accommodation. The Canadian Aid under the Colombo Plan is providing a 500-ton cold storage plant for holding fish, with 40 tons per day ice production and 15 tons per day blast freezing equipment, and this is being planned in association with a pier for trawler unloading and provisioning, and accommodation for gear storage, repair workshops and offices. This unit will probably form the nucleus of the National Fishing Corporation, when that body is established. At present, all trawler landings are handled by the Co-operative Fish Sales Union, which provides sales facilities on a direct-from-producer-to-consumer basis under the supervision of technical personnel provided by the Government Co-operative and Fisheries Departments.

BRACKISH-WATER FISHERIES

The backbone of the island's fishing operations, is, however, the beach seine, a large net which is set out in an arc from the beach, often extending 1½ miles out to sea, and drawn up to the shore by manual labour. The opinion has been expressed that this fishery has reached a depletionary phase (8). The owner now continues in the hope of realising one or two bumper harvests during a six-month season, to recoup his expenses. Part of the development programme must be devoted to a more economical and productive utilisation of this man-power. With the introduction of mechanised operations, it is likely that this activity will require less personnel than it now employs. In order to absorb this surplus man-power into productive fishery employment, it is proposed to divert it to cultural operations in the many thousands of acres of brackish water lagoons and marshes which skirt nearly every mile of the country's 800-mile coastline. This technique, which is now an established peasant routine in the Philippines, Indonesia and Malaya, is ideally suited to this Island's requirements (15). The particular species of fish on which the cultural operations are based are available in abundant supply in local waters. They are well-known in the markets, and command a ready sale. The introduction of this technique presents no difficulty other than that which is attendant upon any attempt on the part of a Government to change the established routine of a conservative community, which, on account of its poverty, is steeped in traditional suspicion of any departure from pristine practices. The potential for development is enormous. The market is assured.

FRESH-WATER FISHERIES

The inland fisheries have received little attention save in the very recent past. There are an estimated 140,000 acres of fresh waters, rich in micro-organic life, which however are, in their natural state, almost entirely devoid of any plankton-feeding fish of food value. Some of these waters are perennial, while many dry up more or less regularly during the annual drought. Thus nature performs one of the tasks which the fish-farmer must carry out, if he would have a good yield in return for his labours. The wide distribution which the Giant Gourami, *Osphronemus gourami*, (a vegetation feeder which was accidentally introduced into a large river system about 40 years ago), has achieved, bears ample testimony to the potential which exists for fishes of this type in local waters.

These reservoirs, or 'tanks' as they are called, are scattered throughout the island, some in the well-populated and the majority in the sparsely-populated regions. It is in these sparsely-peopled areas that fish-farming can yield its most significant results, for here the diet of the peasant is notably deficient in protein, and fish farming will ensure the production of protein food in the areas where it is most needed. Marked success has been achieved through the introduction of the Cichlid mouth-breeder, *Tilapia mossambica*; it thrives in fresh and brackish environments, breeds rapidly and yields a fish of reasonable size and good flavour within a single season.

This fish has been widely distributed in rivers, swamps, and tanks throughout the island, and has already found its way into the markets where it is readily bought, reputedly on account of its resemblance to a sea-fish. (The peasantry show a marked preference for sea-fish!) The conditions for growth of *Tilapia*, and indeed of any other food fish, can be improved perceptibly by the removal of mud and silt from the bottom of the pond. This mud contains much organic matter which is of manurial value for crops, and it can be used with advantage as a dressing for arable land. The desilting of these tanks will not only improve their yield of fish but will also increase their water-holding capacity, enabling them to store during the rainy months many more acre feet of water for irrigation purposes than they do today. The effect of increasing progressively the water-holding capacity of the 'tanks' of the dry zone can have far-reaching effects on the development of those areas which are now largely under forest or support a small peasantry at a subsistence level.

Demonstration fish-rearing ponds are being constructed in collaboration with the Agricultural Department in its Experimental Stations and with the assistance of Rural Development Societies and private individuals, to popularize the farming of fish (18). There is so much in common between fresh-water fishery development work and Agriculture that a closer association of the two activities will undoubtedly be of benefit to both. For instance, the advantages of the introduction of fresh-water fish into paddy fields have not yet been appreciated in this country; there is an estimated 7% increase in the yield of rice (16), and the farmer gets a crop of fish as well. The dwarf gourami, *Trichogaster pectoralis*, which has been found most successful for this work in Thailand, has now been successfully introduced and established in Ceylon waters.

The average annual yield from an acre of fresh water may be conservatively put at 500 lbs. although, with careful farming, yields of 7,000 lbs. have been secured in Indonesia. At 500 lbs. per acre, this Island's fresh waters can yield 70 million lbs. of fish a year, almost sufficient to meet the present shortfall. The fresh-water fishery programme aims at establishing stocks in all rivers, tanks and perennial waters, to increase the available supply of food fish, and at maintaining stock ponds for supplying fingerlings to farming areas.

CONCLUSION

The chief obstacle to progress in the industry, apart from finance, is lack of 'know-how'. This is, to some extent, due to the present educational system, which, though it pays court to Agricultural education, does not give any thought to fishery education. A Fisheries Department alone cannot promote the development of the fishing industry. This requires the co-operation of several branches of Government. The inclusion of a course for the study of Fisheries in the Ceylon University will have far-reaching effects on the industry. Much fundamental research, which is essential as a background to an understanding of the lines along which development might take place, will be undertaken in the University. Secondary schools will include the study of fisheries in their curricula in order to prepare students for the University. Literature from more progressive areas of the world, describing the development of fishery science and techniques, will be studied. Finally, technical schools will take up the practical training of those not suited to academic education, and will provide skilled technicians for employment in the many phases of the fishing industry, capture, processing and marketing on the one hand, and boat, net and gear manufacture and maintenance on the other. A new generation will rise up to develop an industry which, in view of the world shortage of food from the land, will bear an ever-increasing responsibility for the production of food for the people from the waters.

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THE GENUS *CYMBOPOGON* SPRENG. IN INDIA, BURMA AND CEYLON

BY

N. L. Bor

Part II

(With 27 text figures)

[*Continued from p.* 916 *of Vol.* 51 (4)]

8. **Cymbopogon clandestinus** (*Nees ex Steud.*) *Stapf* in Ann. Rept. Board Sci. Advice, India, 10 (1918) & in Bull. Imp. Inst., Lond. **27**, 458 (1929).

Andropogon clandestinus Nees ex Steud. Syn. Pl. Glum. 388 (1854).

A perennial grass from a short woody, stout rootstock. Culms slender, stiff, terete, smooth and glabrous even at the nodes, up to 100 cm. tall. *Leaf-blades* linear-acuminate, long-attenuate into a fine filiform tip, rather flaccid, tapered towards the base, up to 45 cm. long, 1 cm. broad, minutely puberulous on the upper surface towards the base, otherwise glabrous, scaberulous on both surfaces, coarsely scabrid on the margins, somewhat glaucous in colour with a prominent mid-rib below; *sheaths* of the upper part of the culm tight, clasping the culms, usually shorter than the internodes, very smooth and glabrous, striate, those lower down and at the base much looser and slipping from the culms, the basal sheaths short; *ligule* rather stiffly chartaceous 3 mm. long.

Inflorescence a narrow, oblong, erect panicle up to 35 cm. long, 4 cm. wide; internodes of axis angled, scabrid or ciliate on one or more of the angles, particularly towards the apex of the inflorescence, branched at the nodes, each branch subtended by a spathe-like sheath which carries a rudimentary blade or is bladeless; branches similar to the internodes but smaller in every way, hairy towards the top, often ciliate on one of the angles, rebranching but usually only once, ending in a spatheole which bears a peduncle crowned by a pair of racemes; spatheole 20-25 mm. long, lanceolate-acuminate in shape when flattened, greyish-green in colour, many-nerved, hyaline on the margins, scabrid on the keel, turning brown; peduncles 5–7 mm. long, wiry, minutely hairy; racemes 20–24 mm. long, divaricate, one subsessile the other shortly pedicelled; joints of the racemes 2.5 mm. long, compressed, glabrous on the back and face, but densely ciliate on the two edges; pedicel similar to the joint; both ending in a toothed excavation. The lowest pair of spikelets in the subsessile raceme are homogamous, ☿ or neuter, pedicel of the pedicelled spikelet very much swollen, all the remaining pairs of spikelets in the two racemes heterogamous. *Hermaphrodite spikelets* oblanceolate-acute in shape 4.5 mm. long, with a short bearded callus. *Lower glume* shape and size of the spikelet, flat on the back but with a deep furrow in the lower third, covered all over with a minute pubescence, 2-keeled in the upper third, ending above in 2 horns, winged in the lower half of the keel, not winged in the upper half, scabrid and ciliate on keels and wings; *upper glume* as long as the lower glume, boat-shaped, keeled above and scabrid on the keel, puberulous over the whole of the dorsal surface, 3-nerved. *Lower floret* empty ; *lemma* an oblong hyaline 2-nerved scale, ciliate on the margins in the upper half ; *palea* absent. *Upper floret* ⚥ ; *lemma* very narrow, cleft to the middle into two subulate lobes, awned in the sinus ; *palea* absent ; *awn* 21 mm. long ; *column* light brown in colour, twisted, 12 mm. long ; *styles* 2 ; *stigmas* plumose ; *stamens* 3 ; *anthers* 1·5 mm. long. *Pedicelled spikelets* 5·5 mm. long, elliptic- or oblong-acute, very hairy. *Lower glume* shape and size of the spikelet, keeled in the upper half and scabrid on the keels, many-nerved, hairy all over the dorsal surface, with nerves becoming prominent with age ; *upper glume* shallowly boat-shaped, 3-nerved, puberulent or villous on the dorsal surface. *Florets* reduced to an oblong hyaline scale as long as the spikelet, wrapped round 3 stamens with anthers 1·5 mm. long.

Burma : Mount Segain, 1827, *Wallich* 8794K (type of *Andropogon clandestinus* Nees) ; ibidem, *Wallich* 8794 I ; Upper Burma, Nov. 1890, *Abdul Huk* ; ibidem, Dec. 1890, *idem* ; ibidem, Kyaukse, 12 Oct. 1890, *Abdul Huk* ; ibidem, Fort Stedman, Jan. 1893, *Abdul Huk* ; Tonbo, Mandalay Dist., 27 Dec. 1906, *R. S. Troup* 5859 ; Railway Mandalay-Maymyo, above Sedaw Rly. Stn., 9 Nov. 1913, *C. G. Rogers*—a sweet - scented grass from which oil may be extracted; Sedaw, near Mandalay, Jan. 1927, *D. Rhind.*—rocky hill-sides; near Tonbo, Mandalay, 5 Nov. 1928, *D. Rhind.* Burmese name : Myet-sat (pungent-tasting grass).

Usually burned to the ground in the dry season, this perennial grass springs up during the rainy months and flowers at the end of the year. According to D. Rhind ,* it occurs abundantly in dry, rocky places, and in open forest on hill-sides.

Rhind distilled about a ton of the grass and obtained a yield of 0·25 per cent. The oil was a light straw-colour, with a pleasant smell, somewhat resembling ginger-grass oil. The chemical analysis carried out at the Imperial Institute confirmed that the odour of the oil resembled that of ginger-grass oil, with a more pronounced odour of carvone, but showed that the oil was not up to the standard of a first-class oil, and the price to be expected was not such as would make the venture a commercial success.

9. **Cymbopogon nervatus** (*Hochst.*) *Chiov.* Gram. da Essenze, 10 (1909).

Andropogon nervatus Hochst. in Flora (1844) 243.

Gymnanthelia nervata (Hochst.) Aschers et Schweinf. in Schweinf. Beitr. Fl. Aethiop. 306 (1867). This page is printed 310, but it comes between 305 and 307.

A. schoenanthus var. *nervatus* Hack. in DC. Monogr. Phan. **6,** 611 (1889).

An aromatic annual grass. Culms 2–5 from the base, erect or geniculate at the base and then rooting at the nodes, up to 2 m. high, sometimes with stilt roots, terete, smooth and glabrous, polished, yellowish to purple-red in colour, simple, rarely branched. *Leaf-blades* linear-acuminate, glaucous-green or purplish, tapering to a very fine filiform tip, rounded at the base, 15-30 cm. long, up to 1 cm. broad, smooth on the upper surface, scaberulous below, coarsely scabrid on the margins ; *sheaths* of the upper part of the culm much shorter than the internodes, fairly tight and clasping, smooth and glabrous, conspicuously ribbed, turning straw-colour, tinged with red or purple, those of the lower part of the culm loose, slipping from the culms ; *ligule* chartaceous, 2–3 mm. long, lacerate on the upper rounded margin.

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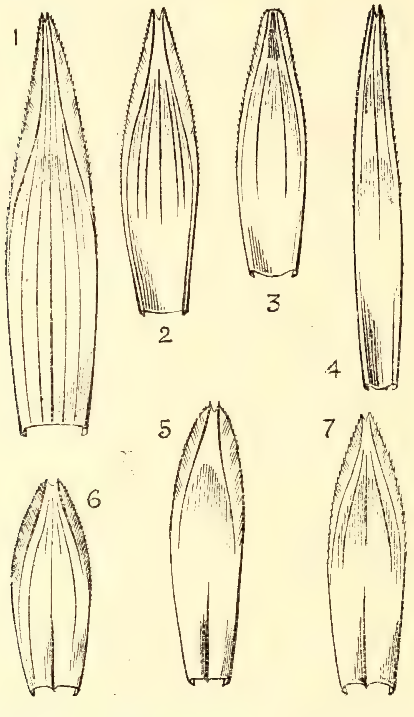
*Agric. Journ. India 326 (1925)

Inflorescence a somewhat simple panicle, 20–40 cm. long, consisting of a central axis with branches arising singly or in small fascicles at the nodes subtended by a bladeless sheath ; branches rebranching to the first or second degree and ending in a spatheole which carries a peduncle crowned by two racemes ; joints of the axis and the branches smooth and glabrous, polished, dilated slightly above ; spatheole 20–30 mm. long, narrowly elliptic-acuminate when flattened, hyaline on the margins, smooth and glabrous, often with a purplish tinge ; peduncle about 20 mm. long, wiry, smooth and glabrous ; racemes in pairs, 1·5–2·5 cm. long. eventually epinastically deflexed, one subsessile the other shortly pedicelled, hairy in the fork ; joints of the racemes 2·5 mm. long, flattened, linear-clavate, densely ciliate on the margins, ending above in an oblique cup toothed along the margins ; pedicels very similar and about the same length. Lower pair of spikelets in the subsessile raceme homogamous, ♂ or neuter, pedicel of the pedicelled spikelet much swollen, glabrous on the back and shining, reddish. *Hermaphrodite spikelets* 4–4.5 mm. long, oblong-oblanceolate acute in outline, with a short bearded callus. *Lower glume* shape and size of the spikelet, 2-keeled in the upper half and very narrowly winged on the keels, shallowly grooved from apex to base with a slit-like groove at the bottom of the former in the lower half, with two green nerves in the keels and 2 others, one on each side of the groove, the tissue between each pair of nerves much thinner and obviously filled with oil cells, coloured light to dark brown, smooth and glabrous on the dorsal surface, scabrid on the wings ; *upper glume* boat-shaped, rounded in the lower half, keeled in the upper and most narrowly winged on the keel, 1-nerved, ciliate on the margins above, very shortly hairy over the dorsal surface. *Lower floret* empty ; *lemma* a hyaline scale, elliptic-acute when flattened, ciliate on the margins above, 2-nerved, often suffused with purple ; *palea* absent. *Upper floret* ⚥ ; *lemma* very narrow, hyaline, split to the middle into two subulate lobes, awned ; *palea* absent ; *awn* 22–25 mm. long, stout ; *column* brown, 10–12 mm. long, strongly twisted ; *styles* 2 ; *stigmas* plumose, purple ; *stamens* 3 ; *anthers* 1·5–2·5 mm. long, yellow. *Pedicelled spikelets* 4·5 mm. long, lanceolate-acute in shape. *Lower glume* shape and size of the spikelet, 8–9-nerved, usually with brown streaks between the green nerves, obscurely keeled in the upper half, smooth and glabrous ; *upper glume* as long, rounded on the back, 3-nerved, smooth and glabrous. *Florets* reduced to a hyaline scale, 3·5 mm. long wrapped around the three stamens ; *anthers* 3 mm. long, often much smaller.

Burma : Minbu Steamer Ghat, 12 Dec. 1908, *Burkill* and *McKenna*, ex Herb. R.E.P. Govt. of India, 31550. Purplish grass growing on dry hill slopes—generally up through bushes—the smell is like that of sofia, very strong—no use is made of it, Shwebandaw,

23 Jan. 1912, *C. G. Rogers*, no. 34390 in Herbarium R.E.P. Govt. of India ; Tatkon, 28 Nov. 1927, *U Ba Thein*—3′–4′ high, in dry places ; Tatkon, 7 Nov. 1928, *D. Rhind* 928, 4′–5′ high, erect tufts ; Mahlaing Township, 17 Nov. 1928, *E.B. Minus* 1 : 77 inches high, rocky hills ; Tatkon, 2 Dec. 1929, *D. Rhind* 928 ; Allanmyo, 3 Nov. 1939, *U Thein Lwin* 3201 ; South Pegu Division (Kyidaung Kan Zamethu), P.O. Zaung Range, 30 Nov. 1939, *U Thein Lwin* 71 ; Allanmyo, 23 Nov. 1947, *U. Thein Lwin* 378—found growing wild by the motor road near mile post 228. Bur. Myet-nan.



Lower glumes of the hermaphrodite spikelets of

1. *Cymbopogon nardus* Linn. var. *confertiflorus* (Steud.) Stapf ; 2. *C. nardus* Linn ; 3. *C. winterianus* Jowitt ; 4. *C. citratus* (DC.) Stapf ; 5. *C. martinii* (Roxb.) Wats. ; 6. *C. caesius* (Nees) Stapf ; 7. *C. polyneuros* (Steud.) Stapf. All × 10.

A note by Rhind reads ‘ This grass was first collected by A. McKerral in November 1918, and Rhind made collections in the same locality in 1927 and 1928. It occurs on dry sandy soils in *indaing* forest and on rocky slopes, where its reddish-purple colour makes it conspicuous. Specimens sent to Kew in 1928 were reported to belong to a new species near *Cymbopogon clandestinus* Stapf but differing from it in the glabrous pedicelled spikelets. No description appears to have been published. In the field the plant is quite distinct from *C. clandestinus* Stapf and *C. martinii* Wats., the main differences being its smaller size, deep purple-red colour, the thick barrel-shaped bottom internodes of the racemes (cf. *C. coloratus* Stapf), the broadly grooved fertile glume and the glabrous pedicelled spikelets. The purple colour is retained in the dried specimens.

Samples of the grass were steam distilled in 1927 and yielded 0·7 per cent. of an aromatic oil similar to the oil of *C. clandestinus* Stapf but differing in the optical rotation being negative instead of positive.

The grass is utilised as an inferior fodder in times of scarcity.'

I am unable to point to any morphological differences of specific value which could be used to separate the Burma specimens from *C. nervatus* (Hochst.) Chiov. The known distribution of this latter plant has hitherto been confined to the Sudan and neighbouring areas in very dry and hot regions. It is, therefore, surprising to find it in Burma, nearly 3,000 miles away, where it also grows in hot, dry, inhospitable places. This is, however, not an isolated instance of such a discontinuous distribution, for the grass *Urochloa mosambicensis* (Hack.) Dandy was collected by Wallich as early as 1826 in the neighbourhood of Yenangyaung, also in the dry belt. This species of *Urochloa* is an inhabitant of Central East Africa How these two grasses arrived in their present habitats after a journey which must have involved crossing the ocean and then traversing an area of high rainfall, can only be pure speculation. Rhind [*Nature* n. 4058, 195 (1947)] presumes that the introduction of *Urochloa mosambicensis* took place accidentally, the seeds being carried by boat up the Irrawadi to the dry areas of Central Burma. *Cymbopogon nervatus* Chiov. can only have reached its present habitat in the same way.*

One must point out, however, that the inflorescences of the African plant are far more congested than those of the Burmese plant, and that the stems do not appear to develop the purple colour that some of the Burmese specimens possess. A specimen at Kew which had been grown in the Cairo Botanical Garden is very different in facies from the desert plant growing in its own home in Eritrea or in the Sudan. The dry tract of Burma is only dry in comparison with surrounding humid areas and could not be compared with the Sudan or Eritrea for heat or dryness. A plant from Eritrea or the Sudan would find conditions in the dry tract very mild compared with those in its own home.

10. **Cymbopogon hookeri** (*Munro ex Hack,*) *Stapf ex Bor* in Ind. For. Rec. (Bot.) 1, 3, 92 (1938).

Andropogon hookeri Munro in Cat. Pl. Griffith, Falconer & Helfer, 58 (1865) nomen.

A. hookeri Munro ex Hack. in DC. Monogr. Phan. 6, 614 (1889).

A perennial (?) grass. *Culms* up to 2 m. tall, slender, terete above, strongly compressed below, smooth and glabrous, polished, simple. *Leaf-blades* 30–40 cm. long, up to 6 mm. broad, linear-acuminate, very long-attenuate to a filiform tip, flaccid or rigid, pale below, many-nerved with all the nerves except those in the middle very coarsely scabrid with forwardly directed teeth, coarsely scabrid on the margins, smooth on the lower surface, glabrous on both surfaces ; *sheaths* extremely smooth and glabrous, becoming almost coriaceous, striate when young, very strongly compressed, keeled on the dorsal surface, the basal sheaths very short and loose; *ligule* 3–4 mm. long, membranous to chartaceous, glabrous.

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*Just as this paper was going to press, a glance through the ' dubia ' sheets from Siam revealed that this grass seems to be common in that area. This fact suggests that the main area of distribution may well be southeast Asia, and that its presence in Africa may be due to casual introduction in the reverse direction from that suggested above.

Inflorescence a very loose lax panicle up to 40 cm. long, the central axis with smooth and polished internodes, each node carrying a spathe-like sheath which is smooth, glabrous and shining, and usually bladeless, giving rise to 1–3 branches each of which may branch again, eventually ending in a spatheole which subtends the ultimate unit, a peduncle crowned by a pair of racemes; spatheole 2-3 cm. long, very narrowly elliptic-acute, smooth and glabrous; peduncle 3–4 cm. long, wiry, flexuous, very smooth and glabrous; racemes 13 mm. long, one subsessile the other with a pedicel 3·5 mm. long, ciliate on the edges, not epinastic, slightly divaricate; joints of the raceme 3 mm. long, linear, expanded above into a toothed oblique excavation, somewhat compressed, glabrous on the surfaces but densely ciliate on the angles; lower pedicels similar in shape but longer, upper pedicels clavate, with a large 2-toothed apical cup into which fits the base of the pedicelled spikelet, 3 mm. long. Lowest pair of spikelets in the sessile raceme homogamous, ♂ or neuter, pedicel of the pedicelled spikelet not swollen, all other pairs of spikelets of both racemes heterogamous. *Hermaphrodite spikelet* linear-acuminate in shape, awned, 5·5–6·5 mm. long. *Lower glume* shape and size of the spikelet, 2-nerved, coriaceous or chartaceous, with a deep concave furrow almost the whole length of the glume leaving the 2 nerves as ridges which are scabrid above, puberulent at the bottom of the groove, truncate or obscurely 2-lobulate; *upper glume* compressed, becoming keeled in the upper third, scabrid on the keel, otherwise smooth and glabrous, tapering, acuminate at the tip, mucronate, almost shortly awned. *Lower floret* empty; *lemma* an elliptic-acute hyaline scale, 3-nerved, hyaline, ciliate on the margins; *palea* absent. *Upper floret* ⚥; *lemma* very narrow, 4 mm. long, linear, split from the apex to the middle into two setiform lobes, awned in the sinus; *palea* absent; *awn* 15 mm. long; *column* darker brown, twisted, 6 mm. long; anthers, styles and stigmas not seen; grain 3·5 mm. long, fusiform; *embryo* half the length of the grain. *Pedicelled spikelet* elliptic-acuminate in outline, 5–5·5 mm. long. *Lower glume* size and shape of the spikelet, 2-keeled in the upper third and scabrid on the keels, otherwise smooth and glabrous, with a strong median nerve and 2 keel nerves, and an indefinite number of faint-nerves in between; *upper glume* 3 nerved, long-ciliate on the margins in the upper third. *Lemmas* reduced to a single hyaline scale nearly as long as the spikelet; *stamens* 3; *anthers* 1·5 mm. long.

Ind. Or.: Bhutan, *Griffith* 6767 (holotype in Herb. Kew.); Assam, Aka Hills, 1933, *Bor* s.n. (in Forest Herbarium, Shillong).

A rare grass, known only from the two collections named.

11. **Cymbopogon tibeticus** *Bor*, in Kew Bull. **1953**, 275 (1953).

A wiry tufted non-aromatic perennial grass clothed at the base with many scarious, pale yellow sheaths. *Culms* up to 45 cm. tall, very smooth and glabrous, shining, terete. *Leaf-blades* mostly from basal sheaths, narrow, linear, tapering to a sharp point, loosely covered on the upper surface with silky, long, white hairs which are quite distinctive, minutely scabrous on the upper surface, and also on the margins, rarely flat, usually folded in various ways ; *sheaths* shorter than the internodes, smooth and glabrous, lower very short ; *ligule* a lacerate membrane 3 mm. long.

Inflorescence a panicle consisting of pairs of racemes subtended by spathe-like sheaths ; spathes supporting the racemes narrow, acuminate, 2·5 cm. long, reddish, smooth and glabrous ; spiciform racemes not epinastic at maturity (?), occasionally branching, unequal, one sessile or shortly pedicelled, (pedicel 1 mm. long, villous), with a ♂ sessile spikelet and a ♂ pedicelled spikelet at the base, 4-noded ; the other pedicelled (pedicel 4·5 mm. long, villous with white hairs), with a ⚥ sessile spikelet at the base accompanied by a ♂ pedicelled spikelet, 5-noded; joints 3 mm. long, clavate, ciliate on the margins, hairy on both surfaces particularly below, cup-shaped and 2-toothed at the apex ; pedicel of pedicelled spikelet 1·75–2mm. long, truncate and concave at the apex, armed with two stout teeth on either side, plano-convex in section ciliate on either margin with cilia increasing in length from below upwards. Lowest pair of spikelets in the subsessile raceme homogamous, ♂, pedicel of the pedicelled spikelet short but not swollen, all the remaining pairs of spikelets in both racemes heterogamous. *Hermaphrodite spikelets* narrowly oblong-acute, 4·5–5 (6) mm. long, with a short bearded callus. *Lower glume* somewhat truncate or 2-toothed at the tip, deeply concave between the two keels, scabrid on the two keels in the upper half, dark purple in colour, smooth and glabrous, nerveless between the keels ; *upper glume* boat-shaped, keeled in the upper half, rounded below, scabrid on the keel, smooth and glabrous elsewhere, chartaceous, 3-nerved, stained with purple, *Lower floret* empty ; *lemma* a hyaline scale 4·8–5 mm. long, almost 2-keeled, with two hyaline ciliate flaps which embrace the upper floret ; *palea* absent. *Upper floret* ⚥ ; *lemma* narrowly oblong, 4 mm. long, cleft to the middle into two narrow glabrous lobes, awned in the sinus ; *palea* absent ; *awn* 8 mm. long ; *column* 4 mm. long ; *styles* 2 ; *stigmas* plumose, purple ; *stamens* 3 ; *anthers* 2·5–3 mm. long. *Pedicelled spikelet* lanceolate-acute in shape, 5 mm. long ; *lower glume* shape of the spikelet, 2-keeled, scabrid on the keels, flat or convex on the back, glabrous except for the scabrid upper halves of the keels, margins incurved, clasping the upper glume, 7-nerved ; *upper glume* length of the spikelet, boat-shaped, rounded on the back, somewhat keeled towards apex, scabrid on the keel in the upper third, otherwise smooth and glabrous. *Lower floret* empty ; *lemma* shape of and somewhat shorter than the spikelet, 2-nerved, the hyaline margins wrapped round the upper floret ; *palea* absent. *Upper floret* ♂ ; *lemma* a narrow hyaline scale 2 mm. long, sometimes split almost to the base or absent altogether ; *palea* a triangular scale 0·5–1 mm. long or absent ; *stamens* 3 ; *anthers* 2·5 mm. long.

Tibet: Kyi Chu Valley, 15 miles east of Lhasa, 3000 m., Aug. 1904, *Capt. H. J. Watson* (type in Herb. Kew.) ; Tsangpo Valley, 3–3,500 m., 14 Aug. 1935, *Kingdon-Ward*,—sand binder ; Tsangpo valley, 3,000–3300 m., 19 Jul. 1935, *Kingdon-Ward* 12022—grass which grows in the sand, helping to bind it, and forms turf in which flowers grow. (K. & B. M.) ; Kongbo, Kyikar, 3100 m., 27 July 1938, *Ludlow, Sherriff & Taylor* 5446—on rocks. Glumes purple, styles dark purple, (B.M.) ; vicinity of Lhasa 3300 m., July 1939, *H. E. Richardson* 273—grass (B.M.) ; Hills south of

Lhasa, 4000 m., 11 July 1943, *Ludlow* and *Sherriff* 9745-on sandy open grassland (B.M.).

Little is known about this grass and nothing about its oil.

12. Cymbopogon gidarba (*Ham.*) *Haines*, Bot. Bihar & Orissa 1048 (1924).

Andropogon gidarba Ham. ex Wall. Cat. no. 8797, nomen.

A. gidarba Ham. ex Hook. f. Flor. Brit. Ind. 7, 208 (1896).

A perennial caespitose grass. *Culms* up to 80 cm. tall, erect, very slender, terete, smooth and glabrous, polished, even at the nodes. *Leaf-blades* linear-acuminate in shape, up to 25 cm. long, 5 mm. wide, often very much narrower, rounded at the base to the sheath, rigid, somewhat glaucous, glabrous on both surfaces or minutely hairy on the upper surface, with widely spaced long hairs on the margins at the base, scabrid on both surfaces and very scabrid on the margins, tip very long acuminate, almost filiform ; *sheaths* clasping the culms, smooth and glabrous, striate ; *ligule* membranous, becoming chartaceous, 1 mm. long.

Inflorescence a short panicle 5–30 cm. long, 2·5 cm. wide, often of pedunculate pairs of racemes racemosely arranged on a 3–4-noded axis, less often the branches branching and rebranching simulating a decompound panicle, 6–8-noded ; branches somewhat compressed, striate, sometimes densely ciliate along one edge, usually smooth and glabrous ; racemes 1·5–2 cm. long, divergent, ultimately forming a straight line, one subsessile, the other shortly pedicelled, very hairy in the fork ; spatheoles 16–20 mm. long, narrowly lanceolate, nerved, turning reddish or brownish-red ; peduncles 6 mm. long, slender, capillary, smooth and glabrous, enlarged at the tip ; joints of the fragile racemes 3 mm. long, linear-clavate in shape ending in an oblique excavation which is 2-toothed on the margin, densely hairy on the two edges and villous on the lower third of the back ; pedicels somewhat similar, much compressed, with a long tooth on the edge of the oblique tip. Lowest pair of spikelets in the subsessile raceme homogamous with the pedicel of the pedicelled spikelet much swollen and adnate to the joint, ♂, all the remaining pairs in both racemes heterogamous. *Hermaphrodite spikelets* 4–4·5 mm. long, narrowly linear-acute, with a short bearded callus. *Lower glume* shape and size of the spikelet, with a coriaceous boss just above the callus, and above that with a concave groove extending almost to the tip, 2-keeled, glabrous or puberulous in the groove, otherwise glabrous, nerveless between the keels, several-nerved outside, 2-toothed at the tip, scabrid on the keels, not winged ; *upper glume* boat-shaped, rounded on the back below, keeled above, as long as the spikelet, smooth and glabrous, scabrid on the keel. *Lower floret* empty ; *lemma* a hyaline scale, 3 mm long, lanceolate, ciliate on the margins at the tip ; *palea* absent. *Upper floret* ⚥ ; *lemma* 2·5 mm long, very narrow, split half-way down into two very narrow ciliate lobes, awned in the sinus ; *palea* absent ; *awn* 12 mm. long ; *column* 5 mm. long ; *stamens* 3 ; *anthers* 1·5 mm. long. *Pedicelled spikelet* ♂, lanceolate-acute. *Lower glume* shape and size of the spikelet, keeled in the upper half many-nerved with strong median and keel-nerves, scabrid on the keels ; *upper glume* similar in size and shape, more delicate in texture, 3-nerved. *Florets* reduced to a hyaline scale 3 mm. long ; *stamens* 3 ; *anthers* 1·5 mm. long.

Ind. Or.: Himalaya; Tara Devi, near Simla, 2000–2500 m, 24 Aug. 1889, *J. F. Duthie* 10098; Kumaon, Kalemath, 1600 m., *Strachey & Winterbottom* 2; Chenab, Aknur, (Jammu), 1871, *Falconer*; between Nachar and Taranda, Bashahr, 2100 m., 22 Oct 1933, *R. N. Parker* 3289.

Madhya Pradesh; Koderma forest, Hazaribagh, 12 Nov. 1916, *H. H. Haines.*

Bihar & Orissa; Monghyr, Oct. 1894, *Mokim* 1410 & 1411; Gaya, Oct. 1894, *Mokim* 1332; in montibus Mongger (Monghyr) *Ham.* ex Herb. Wall. no 8797 (type of *Andropogon gidarba* Ham.).

Madras; Bellary Dist., 1886, *J. S. Gamble*; ibidem 1889, *J. S. Gamble*; Chingelput Dist., Kambakam Drug, 16 Mar. 1901, *Bourne* 2452; Tinnevelly Dist., Agostiarmalai, 22 May 1901, *Barber* ?; Mysore, Yelaigi, 5 Oct. 1903, *Barber* 6135; Cuddapah, 18 Nov. 1905, *Barber* 6418; Nellore, Kamigeri, 7 Apr. 1905, *Barber* 6619; Mysore, Oorgaum, 1907, *F. Roskrow*; Vizagapatam Dist., Palakonda, 18 Dec. 1923, *K. C. Jacob* 17259.

This species is readily separated from all other species by the pronounced boss at the base of the slotted lower glume of the hermaphrodite spikelets. Guenther does not mention this grass, so apparently nothing is known of its oil. Hook. f. remarks that it smells of terebinthine.

var. **burmanicus** Bor var. nov. a typo ramis binis, pedunculis longissimis e spatheolis plerumque valde exsertis recedit.

Burma; Sagaing, Taungnyotaung, 300 m, 20 Oct. 1928, *Sukoe* 7873; Sagaing, Talaing Ywa, 150 m., 16 Oct. 1928, *Sukoe* 7855; Meiktila Dist., Mahlaing, 26 Oct. 1947, *U Thein Lwin* 345—not common, growing on calcareous stiff clay soil in the open; Magwe Dist., 28 Nov. 1947, *U Thein Lwin* 380—fairly common on calcareous stiff clay soil in the dry zone.

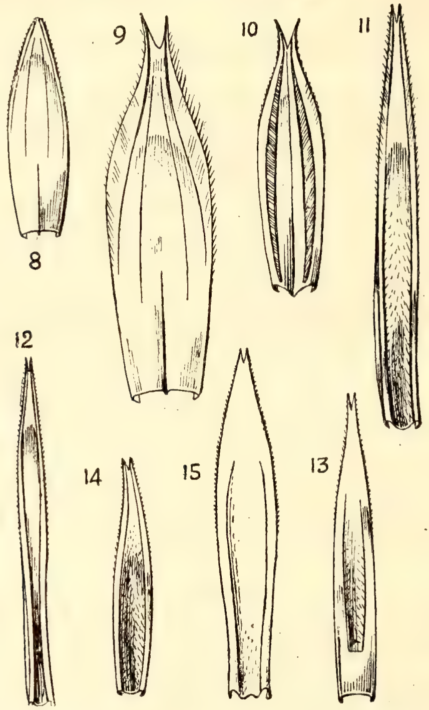
In appearance this grass is utterly different from typical *C. gidarba*, but apart from the very long branches and peduncles, which give the grass a very different appearance, I am unable to find any difference between the two which would justify the grant of specific rank.

13. **Cymbopogon microtheca** (*Hook. f.*) *A. Camus* in Rév. de Bot. Appl. **1**, 284 (1921).

Andropogon microtheca Hook. f. Flor. Brit. Ind. **7**, 208 (1896).

A perennial grass, apparently not aromatic. *Culms* up to 120 cm. tall, simple, erect, terete, smooth and glabrous even at the nodes. *Leaf-blades* flat, linear, up to 1 m. long, exceptionally up to 1 cm. wide, usually very much less, 1–3 mm., long-attentuate to an almost filiform point, glabrous, smooth or minutely scabrous, coarsely scabrid on the margins, with a very marked mid-rib, hardly contracted at the base to the sheath; *sheaths* usually much shorter than the internodes, auricled, turning red inside, those above very tight, clasping the culms, smooth and glabrous, striate, the lower and basal sheaths much looser and slipping from the culms, straw-coloured, very smooth and glabrous, rather coriaceous, polished; *ligules* coriaceous about 1 mm. long.

Inflorescence an elongate narrow panicle, very loose, erect, about 40 cm. long by 3–4 cm. wide, giving the impression of a vertical axis covered closely with vertical spathe-like bladeless sheaths from which project horizontal divaricate spatheoles, each of which bears a peduncle crowned with two epinastic racemes in its axil; axis covered by the supporting spathes, smooth and glabrous; branches and branchlets similar, capillary; spatheoles 1–1·2 cm. long, lanceolate-acuminate in shape, smooth and glabrous, hyaline on the margins, very many-nerved, turning a bright reddish-brown inside, brownish-red outside; peduncle 4–5 mm. long, smooth and glabrous, dilated at the tip, racemes two, eventually epinastic, 4–6 mm. long, one subsessile the other shortly pedicelled, very hairy in the fork; joints of the raceme obconical, flattened on the inner face, smooth and shining on the convex back, densely ciliate on the edges, 2 mm. long, ending above in an oblique 2-toothed excavation; pedicel similar in shape but slightly shorter. Lowest pair of spikelets in the sessile raceme homogamous, ♂ or neuter, pedicel of the pedicelled spikelet much swollen, shining, polished, all other pairs of spikelets in both racemes heterogamous. *Hermaphrodite spikelets* linear-acute in shape, 2·5–3·5 mm long, with a minute bearded callus. *Lower glume* shape and size of the spikelet, bifid at the apex, keeled in the upper half,



Lower glumes of the hermaphrodite spikelets of

8. *Cymbopogon osmastonii* Parker; 9. *C. clandestinus* (Nees ex Steud.) Stapf; 10. *C. nervatus* (Hochst.) Chiov. 11. *C. hookeri* (Munro ex Hack.) Stapf; 12. *C. tibeticus* Bor; 13. *C. gidarba* (Ham.) Haines; 14. *C. microtheca* (Hook. f.) A. Camus; 15. *C. stracheyi* (Hook. f.) Raiz. et Jain. All × 10.

with a deep groove in the middle line, puberulent in the groove, scabrid on the keels ; *upper glume* boat-shaped, compressed, keeled in the upper half, rounded below, smooth and glabrous, scabrid on the keel. *Lower floret* empty ; *lemma* a hyaline scale 2 mm. long, 2-keeled, 2-nerved, ciliate on the margins above ; *palea* absent. *Upper floret* ☿ ; *lemma* 1·5–2 mm. long, very narrow, hyaline, cleft almost to the middle, awned in the sinus ; *stamens* 3 (?) ; *anthers* not seen ; *awn* 9 mm. long ; *column* chestnut-brown, 2·5 mm. long ; *styles* 2 ; *stigmas* plumose, purple. *Pedicelled spikelet* ♂ ; narrowly elliptic-acute, 3 mm. long. *Lower glume* shape and size of the spikelet, many-nerved, keeled towards the apex, rounded below, smooth and glabrous ; *upper glume* 3-nerved, smooth and glabrous. *Florets* reduced to a hyaline lemma 2·5 mm. long ; *stamens* not seen.

Ind. Or. : East Nepal ; 12 Nov. 1848, *Hook.* f. (type of *Andropogon microtheca* Hook. f.)

Sikkim ; Salim P., 15 Jan. 1877, *J. S. Gamble* 2105B—on rocks at Nan Dunga ; between Tarkola and the Rungpo, Tista valley, 3–400 m., 2 Nov. 1909, *I. H. Burkill* 34034—has no fragrance, is very wiry and grows commonly with *Eriophorum comosum* on rocks over the Tista.

Bihar ; Sameshwar Hills, Ramnagar, Nov. 1916, *H. H. Haines* 5325 (type of var. *sameshwarensis* Haines).

This very peculiar grass is, according to Burkill, not aromatic ; nevertheless, it can only be placed in *Cymbopogon* until more is known of it. Haines' variety *sameshwarensis* seems hardly worthy of varietal rank.

14. **Cymbopogon stracheyi** (*Hook. f.*) *Raizada et Jain*, comb. nov.

Andropogon nardus var. *stracheyi* Hook. f. Flor. Brit. Ind. **7**, 207 (1896).

A perennial aromatic, tufted grass, with thick fibrous roots. *Culms* slender, terete, smooth and glabrous, polished, up to 1 m. tall, erect or very slightly decumbent at the base. *Leaf-blades* very narrow, up to 30 cm. long, 2–3 mm. broad or less, folded, convolute or involute, rather glaucous, flexuous, linear, tapering to a fine filiform tip, scabrid on the outer nerves and on the margins, glabrous on both surfaces from the middle upwards, but often with a covering of very short hairs on the upper surface towards the base; ligule membranous, 3 mm. long, lacerate.

Inflorescence an erect panicle varying from an almost simple raceme of pedunculate raceme-pairs to a fairly complicated panicle with branches rebranching up to the third and fourth degree, up to 35 cm. by, at most, 8 cm. broad, often much shorter and narrower ; axis of the panicle straight, each internode enveloped in a sheath which carries a rudimentary blade which becomes progressively shorter until the topmost sheaths carry only an arista ; internodes terete, shining, polished, smooth and glabrous, dilated at the apex ; branches similar but more slender, the sheaths becoming more and more like spathes, smooth and glabrous, brownish on the hyaline margins ; spatheoles 16–27 mm. long, narrowly elliptic-acuminate, smooth and glabrous, hyaline on the margins, striate ; peduncle very short, much shorter than the spatheole, not more than 10 mm. long, often much shorter ; racemes 12–22 mm. long, one sessile the other definitely pedicelled, the lowest pedicel in the subsessile raceme not swollen, the lowest pair of spikelets in the subsessile raceme homogamous, ♂ or neuter, all the other pairs in both racemes heterogamous; joints of the racemes 2 mm. long, compressed, ciliate on the edges, expanded and toothed at the tip. *Hermaphrodite spikelets* 4·5 mm. long, linear-acute in shape, with a short bearded callus. *Lower glume* shape and size of the spikelet, keeled in the upper half, most narrowly winged on the keels, definitely depressed on the back with the indications of a boss at the lower end of the groove, with 2 green nerves in the keels, scabrid on the keels, glabrous or with a minute wool on the dorsal surface; *upper glume* as long as the lower glume, boat-shaped, rounded on the back in the lower half, keeled above, scabrid on the keel, otherwise smooth and glabrous, 3-nerved, the two lateral marginal and very faint. *Lower floret* empty; *lemma* a hyaline scale 4 mm. long, 2-keeled; *palea* absent. *Upper floret* ⚥; *lemma* very narrow, cleft to the middle into two ciliate lobes, awned on the sinus; *palea* absent; *awn* 11 mm. long; *column* brown, twisted, 5 mm. long; *styles* 2; *stigmas* plumose; *stamens* 3; *anthers* 2 mm. long. *Pedicelled spikelets* 4·5–5·5 mm. long, lanceolate- or elliptic-acute in shape, dorsiventrally compressed, with a glabrous callus. *Lower glume* shape and size of the spikelet, flat or slightly convex on the back, many-nerved, 2-keeled in the upper half, scabrid or even ciliate on the keels; *upper glume* equal in length, shallowly boat-shaped, smooth and glabrous, 3-nerved, scabrid on the nerves in the upper third. *Florets* reduced to a hyaline oblong-acute scale with infolded ciliate flaps; *stamens* 3; *anthers* 2 mm. long.

Ind. Or.: Bashahr, Pauni, Sept. 1864, 2500 m., *Brandis* 3142; N.W. Himalaya, Pangi, *Dr. Stoliczka* (type); Kalemath, Kumaon, 1900 m., *Strachey and Winterbottom* 4; Sutlej valley near Rampore, Aug. 1847, *Hooker and Thompson*; Herb. *Falconer*; Simla, *Fielding*; N.W. India, 1876, *Brandis*—the common grass on the low slopes of the Kulu valley to the Sultan pass. Eaten when young. Root scented; Gilgit, Nittar valley, 2–2500 m., 3 Aug. 1892, *J. F. Duthie* 12328; Larji, 1050 m., 30 May 1933, *R. N. Parker* 3271; Bashahr, Rampur-Gopalpur, 1 Oct. 1950, *M. B. Raizada* 19740; ibidem, near Nireth, *M. B. Raizada* 19688 and 19694.

C. stracheyi seems to be confined to the comparatively very small area of Bashahr State and the neighbouring Kangra. It has not been collected anywhere else in the Himalaya.

It has, for long, been suspected of being a hybrid, with *C. gidarba* as one of the parents, on account of the deeply grooved lower glume to the hermaphrodite spikelet which ends below in what can be termed the rudiments of a boss. From the general appearance of the grass, and its widely divergent racemes, one can only assume that the other parent is *C. distans*.

The plant flourishes on the open hillsides of somewhat inhospitable country. Only one of the collectors noted that it was an aromatic grass. Nothing is known of the oil.

In the Flora of British India, Hook f. quotes two sheets as the basis of his *C. nardus* var. *stracheyi* viz. (1) Dr. Stoliczka's sheet from Pangi, and (2) Strachey and Winterbottom's no. 2 from Kalemath, Kumaon. The first named sheet is correct, but the second contains a specimen of *C.*

distans collected at Simla, and not in Kumaon. There is, however, a Strachey and Winterbottom's sheet which was collected at Kalemath, Kumaon, and the specimen matches that on Dr. Stoliczka's sheet. The number of the sheet is no. 4, and is obviously the specimen to which Hook. f. refers and numbered 2 in error.

15. Cymbopogon flexuosus (*Nees ex Steud.*) *Wats.* in Atkins. Gaz. N. W. Prov. Ind. 392 (1882).

Andropogon flexuosus (Nees) ex Steud. Syn. Pl. Glum. 388 (1854).

A. nardus Linn. subsp. *flexuosus* (Nees) Hack. in DC. Monogr. Phan. 6, 603 (1889).

A tall aromatic perennial from a short thick rhizome. *Culms* up to 3 m. tall with a nodding inflorescence, terete, stout, smooth and glabrous, polished, solid, glabrous at the nodes. *Leaf-blades* linear-acuminate, tapering at both ends, attenuate upwards to a long almost filiform tip, glaucous-green, sometimes suffused with purple or a reddish tinge, minutely scabrid on both surfaces, coarsely scabrid on the margins and the outer nerves, coarsely hairy on the upper surface towards the base, shortly hairy on the lower surface at the junction with the sheath, over 1 m. in length, up to 1·5 cm. wide; *sheaths* of the culms tight, clasping the culms, striate, smooth and glabrous, glaucous-green or with a tinge of purple, densely hairy at the junction with the blade; lower sheaths very loose, long, persistent and becoming leathery, curled, falling away from the culms; *ligule* chartaceous to coriaceous when old, 2–3 mm. long.

Inflorescence large, loose, with many long flexuous drooping branches, branching and rebranching, and ending in a spatheole subtending a pair of racemes seated upon a peduncle, up to 60 cm. long and 30 cm. broad; axis of the inflorescence often 12-noded; joints smooth and polished, slightly expanded at the tip, often flattened on one face, rounded on the back, smooth and glabrous, but ciliate or villous towards the top on the edges, usually villous just at the node; branches and branchlets similar; spatheole 18–20 mm. long, narrowly elliptic-acuminate when flattened, many-nerved, hyaline on the margins, greyish green, turning a pale red or brownish red; peduncle 3–3·5 mm. long, wiry, smooth and glabrous but shortly hairy near the tip; racemes 15–20 mm. long, one subsessile, the other shortly pedicelled, very hairy in the fork; joints of the raceme 2·5 mm. long, somewhat compressed, linear, expanded at the tip, densely ciliate along the margins; pedicel similar but shorter. Lowest pair of spikelets in the subsessile raceme homogamous, ♂, pedicel of the pedicelled spikelet not swollen but very short, all remaining pairs in both racemes heterogamous. *Hermaphrodite spikelets* 4·5–5 mm. long, with a short bearded callus, oblong-acute or widest above the middle. *Lower glume* size and shape of the spikelet, 2-keeled from the middle upwards, winged on the keels, smooth and glabrous but scabrid on the margins of the keels, flat on the back or shallowly concave below, obscurely or clearly 1–3-nerved between the carinals in the upper third; *upper glume* length of the spikelet, boat-shaped, rounded on the back below, keeled in the upper third and winged on the keel, smooth and glabrous, scabrid on the keel. *Lower floret* empty; *lemma* a lanceolate-acute hyaline scale, 2-keeled, ciliate on the flaps; *palea* absent. *Upper floret* ☿; *lemma* narrow, hyaline, cleft to the middle, awned in the sinus; *palea* absent; *awn* 12 mm. long; *column* 5 mm. long, twisted; *styles* 2;

stigmas plumose, purple; *stamens* 3; *anthers* 1.75–2 mm. long; *lodicules* truncate-cuneate. *Pedicelled spikelets* ♂ or neuter, elliptic-acuminate in shape, 3·5 mm. long. *Lower glume* many-nerved, smooth, glabrous; *upper glume* 3-nerved, boat-shaped, smooth and glabrous. *Florets* reduced to a lanceolate-acute hyaline scale 3 mm. long; *stamens* 3; *anthers* 2 mm. long.

Cymbopogon flexuosus in its typical state is easily recognisable from its ample panicle with drooping branches, crowded raceme pairs which are finally epinastic, and small sessile spikelets. It is typically at home in Madras and is possibly one of the commonest Cymbopogons in that State. Towards northern India and to the north-east it tends to merge into *C. pendulus* without, however, acquiring the distinctive characteristics of that plant. It does, however, lose the 'bunchiness' of the panicle and the drooping branches are therefore simpler. As this form becomes at times distinct and easily recognisable, I have given it varietal rank as var. *sikkimensis*. Where the simplification of the panicle is carried a stage further, another distinct form emerges—var. *microstachys*.

C. flexuosus (*Nees ex Steud.*) *Wats.* var. **flexuosus** Bor. panicula decomposita, congesta.

Ind. Or.: Madras; Quilon, Travancore, 29 Oct. 1904, *C. A. Barber* 6718; Nilgiris, Berliar, 12 Feb. 1901, *Bourne* 2547; Pulneys, Gundar valley, 10 Jun. 1901, *Bourne* 1446; Annamalays, Poonachi, 10 Oct. 1901, *C. A. Barber* 3762; Nilgiris, Kullar F.H., Oct. 1889, *J. S. Gamble*, 21398; South Arcot, Melpat, 20 Sept. 1899, *C. A. Barber* 1073; N. Coimbatore, Salzygamullam, Mar. 1902, *Bourne*; Coorg, Chandanathode, 3 May 1940, *N. L. Bor* leg. s.n.; Wynaad, 3 May **1940,** *N.L. Bor* leg. s.n.; Wynaad, 24 Nov. 1939, *N. S. Kaikini*; Cochin, Feb. 1905, *C. B. Barber* 2934—raised from seed; Coimbatore, Kollegal, 13 Feb. 1930, *V. Narayanaswami* 19916; South Canara, Mangalore, Jan. 1902, *C. A. Barber* 4825; Coonoor, 1900 m., leg. *D. Hooper*; Travancore, hills near Shencotta about 200 m., 26 Nov. 1914, *K. Venkoba Rao*—red variety of Chukkunaripillu; Salem, Devabetta, 25 Feb. 1927, *K. C. Jacob* 18053; High Wavy Mountains, *Blatter and Hallberg* 230; Herb. Wight, 1704 (type of *Andropogon flexuosus* Nees).

C. flexuosus var. **sikkimensis** Bor var. nov. a typo panicula simpliciore, ramis longioribus pendulis recedit.

Ind. Or.: Sikkim; Kynanooka, Terai, Nov. 1878, *J. S. Gamble* 7363; Tuckvar, 19 Sept. 1874, *Treutler* 792; Rungpo, 399 m., 3 Nov. 1909, *I. H. Burkill* 34063—plentiful on rocks over the Tista. Bengal; Darjeeling Dist., below Badamtam, towards the Ranjit, 1 Nov. 1909, *I. H. Burkill* 34012.

C. flexuosus var. **microstachys** (Hook f.) Bor, comb. nov.
Andropogon nardus L. var. *microstachys* Hook, f.

Ind. Or.: Uttar Pradesh; Dehra Dun, Khajanchibagh, 9 Nov. 1928, *Umrao Singh* 404; Kajnair pass, 900 m., Dec. 1890, *J. S.*

Gamble 22392; Saharanpur, *J. S. Gamble* 23994; Chillawalla, Saharanpur, Jan. 1898, *J. S. Gamble* 26436; Siwaliks, Nov. 1895, *J. S. Gamble* 25580; Forests of north Oudh, Jan. 1873, *R. Thompson*, comm. Brandis 381 (type of *Andropogon nardus* L. var. *microstachys* Hook. f.)

Cymbopogon flexuosus is the source of a valuable aromatic oil known as 'Oil of Lemon-grass', but while the grass grows wild in many tropical and semi-tropical parts of Asia, Africa and America, the commercial product is obtained from plantations of the grass formed exclusively for this purpose. In so far as India is concerned, the State of Travancore is the chief producing area, and the plantations of this grass are situated at the foot of the Ghats. As might be expected, local conditions of soil, climate and aspect have an effect upon the quality and quantity of the yield, and the northern districts are alleged to produce a better quality oil.

This grass was considered to exist in two forms, indistinguishable morphologically, but easily separated by the colour of the stems. The red-stemmed variety was believed to be the true Lemon-grass, while the other, a white-stemmed variety, yielded an inferior kind of oil which could not be marketed commercially. Fortunately, there are sheets of both these so-called varieties at Kew, and it can now be stated that the red-stemmed variety is, in fact, true *C. flexuosus.* The white-stemmed variety, while superficially identical with *C. flexuosus,* is actually morphologically distinct, and is the grass which has now been christened *C. travancorensis* Bor. This species was called by Stapf *C. flexuosus* forma *albescens.*

The main constituent of the oil is an aliphatic terpene aldehyde called citral, and it is this substance which gives it the strong odour of lemons. The oil is used in the perfumery trade for scenting soaps, while the purified citral is used in flavours, cosmetics and perfumes. This substance is, according to Guenther, converted into ionones, 'a group of very important synthetic aromatics possessing a strong and lasting violet odour'.

16. Cymbopogon pendulus (*Nees ex Steud.*) *Wats.* in Atkins. Gaz. N. W. Prov. Ind. 392 (1882).

Andropogon pendulus Nees ex Steud. Syn. Pl. Glum. 388 (1854).

A perennial robust grass. *Culms* up to 3 m. tall with stout culms solid at the base, very smooth and glabrous, terete, glabrous at the nodes. *Leaf-blades* up to 90 cm. long. 2 cm. wide, very scabrid on the margins, linear-acuminate in shape, tapering at both ends, contracted gradually and involute at the base till it is hardly broader than the conspicuous mid-nerve, scabrid on both surfaces, glabrous, very glaucous, tasting and smelling of lemons; *sheaths* clasping the culms, striate, smooth and glabrous, rounded on the back, slightly auricled at the insertion of the blade; *ligule* a coriaceous or chartaceous membrane, 2–3 mm. long, ciliate or lacerate on the upper margin.

Inflorescence a pendulous decompound panicle terminating the culm, up to 100 cm. long, 60 cm. broad; axis of the panicle is the uppermost nodes of the culm subtended by spathes 2·5–7·5 cm. long, which seem to sheath the axis, from each of which arise branches which are themselves noded and rebranched, eventually ending in the unit of the inflorescence, a pair of racemes up to 2 cm. long seated on a peduncle and subtended by a spatheole; *spatheoles* 1·5–2·5 cm. long, narrowly elliptic when flattened, compressed, reddish; joints of the raceme and pedicels equal in length, slender, expanding at the tip into a 2-toothed cup; the pedicels more compressed, long ciliate on the margins; joints equally hairy; one raceme short-, the other long-pedicelled, hairy in the fork; lowest pair of spikelets of the short-pedicelled or sessile raceme, homogamous, awnless, male, pedicel of the pedicelled spikelet cuneate, compressed, short, not swollen; all pairs of the pedicelled raceme heterogamous; rhachis of the racemes fragile. *Sessile spikelet* ⚥, 5–6 mm. long, elliptic-acute or -acuminate in shape. *Lower glume* shape and size of the spikelet, shallowly concave along the middle line on the dorsal surface, smooth and glabrous, shining, 2-keeled and narrowly winged on the keels, 2–4-nerved apart from the dark green keel-nerves, without a mid-nerve, very scabrid on the margins of the very narrow keel-wings; *upper glume* boat-shaped, 5·5 mm. long, keeled in the upper half, rounded on the back below, smooth and glabrous except the extremely narrow keel-wing which is scabrid, 3-nerved. *Lower floret* empty; *lemma* a lanceolate-acute hyaline scale; *palea* absent. *Upper floret* ⚥ or ♀; *lemma* very narrow, cleft into two almost capillary lobes, 4 mm. long; *awn* 13 mm. long; *column* twisted, brown, 6 mm. long; *stamens* if present 3; *anthers* 2·5 mm. long; *styles* 2, separate; *stigmas* long, plumose; *lodicules* 2, truncate, cuneate. *Pedicelled spikelet* ♂, elliptic-acute in shape, 6 mm. long. *Lower glume* shape and length of the spikelet, many-nerved, flat on the dorsal surface, rounded on the keels below, almost keeled above, scabrid on the keels, otherwise smooth and glabrous; *upper glume* shape of the spikelet but smaller, 3-nerved, chartaceous, ciliate on the margins. *Lower floret* ♂; *lemma* a hyaline scale clasping the stamens; *palea* absent. *Upper floret* absent; *stamens* 3; *anthers* 2·5 mm. long; *lodicules* 2, truncate-cuneate.

Ind. Or.: Bengal; Bengala, *Griffith* 6763; Andul, 10 Nov. 1909, *Kalka Pershad* 30638; Boradighi Rly. Stn. 22 Aug. 1908, *I. H. Burkill* 30753; Purnea, Paksiri near Kalyaganj, 29 Jan. 1911, *I. H. Burkill* 34144; Banaphat, 24 Aug. 1908, *I.H. Burkill* 30772; Jalpaiguri, Sal forest between Sivoke & Siliguri, *I.H. Burkill* 33425; Darjeeling, between Maligera & Naralbari, 25 Jan. 1911, *I. H. Burkill*; ibidem, Debigaon to Bhatgaon, 24 Jan. 1911, *I. H. Burkill* 34124.

Sikkim; Punkabaree, Oct. 1868, *S. Kurz*; Teesta valley, 1850, *Hook. f.*; Dulkajhar, 100 m., 15 Oct. 1884, *C. B. Clarke* 36873B.

Assam; Khasi Hills, *Griffith* 6759, ibidem, Garo Hills, Tura, 400 m., Oct. 1929, *Parry* 780; Manipur State, Bishenpur, 5 Oct. 1943, *N. L. Bor* 18051—on dry slopes.

Madhya Pradesh; Chanda Dist., forest near Karjeli, 1 Feb. 1890, *J. F. Duthie* 9893.

Nepal; *Wallich* 8794G.

Guenther does not mention the oil which is obtained from this plant on distillation, in his book on Essential Oils. There is, however, a reference to it in Sem. Ann. Rept. Schimmel, 59 (1911), where under the heading 'Lemon-grass oil' it is mentioned that several oils obtained from *C. pendulus* and collected by I. H. Burkill, were sent to Schimmel & Co., New York. No details of the constituents of the oil are given, but one is led to understand that they are similar to those obtained from *C. flexuosus* and *C. citratus*.

Burkill mentions that there are great sheets of this grass beside the river Teesta in Bengal. He also says that the grass is plucked and brought into the house because it smells nice, but that it is not otherwise used.

17. Cymbopogon exsertus (*Hack.*) *A. Camus* in Rév. Bot. Appl. **1**, 287 (1921).

Andropogon nardus Linn. subsp. *marginatus* (Steud.) Hack. var. *exsertus* Hack. in DC. Monogr. Phan. **6**, 608 (1889).

Culms apparently slender, probably not more than 1 m. tall, terete, polished, smooth and glabrous, simple, glabrous at the nodes. *Upper leaf-blades* linear, very long attenuate, ending in an acuminate membranous tip, probably up to 1 m. long, 8 mm. broad, glabrous, very scabrid on both surfaces and on the margins ; *sheaths* shorter than the internodes, striate, clasping the culms, eventually slipping from them, smooth and glabrous ; *ligule* membranous 2-3 mm. long, rounded on the upper margin.

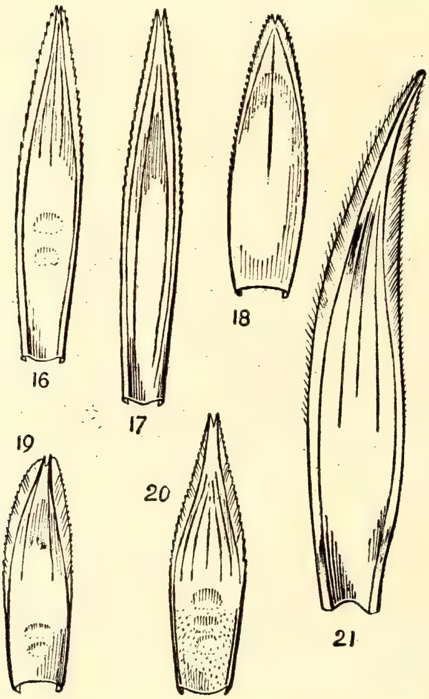
Inflorescence a narrow lax-flowered panicle up to 35 cm. long, 5–6 cm. broad, about 6-noded ; branches and nodes capillary, wiry, smooth and glabrous, sometimes with a few white hairs just below the node, subtended by spathe-like sheaths which are usually without a blade, ending in a spatheole in which is a peduncle crowned by a pair of racemes about 1·5–2 (3) cm. long ; spatheole 1·5–2·5 cm. long, narrowly elliptic-acuminate when flattened, nerved, reddish ; peduncle filiform, slightly expanded above, usually longer than the spatheole ; joints of the raceme about 3 mm. long, slender, widened at the tip into a cup with a toothed crenulate margin, densely hairy on the back and the sides ; pedicel similar in shape about 2·5 mm. long ; one raceme subsessile or shortly pedicelled, the other long pedicelled, hairy in the fork ; lowest pair of spikelets in the subsessile raceme homogamous, pedicel of the pedicelled spikelet not swollen, very short, all other pairs of spikelets heterogamous. *Hermaphrodite spikelets* 3·5–4 mm. long, 0·8 mm. wide, oblong, or elliptic-oblong, or elliptic-obovate-acute, with a short bearded callus. *Lower glume* shape and size of the spikelet, flat on the back or very slightly depressed in the lower quarter, 2-keeled, with or without one conspicuous median nerve, very narrowly winged (almost wingless) on the keels, scabrid on the keels, shining and polished on the lower half ; *upper glume* as long as the spikelet, boat-shaped, rounded in the dorsal surface below, keeled above, scabrid on the keel, otherwise smooth and glabrous. *Lower floret* empty ; *lemma* a lanceolate hyaline 2-nerved scale, 3·5 mm. long, ciliate on the margins in the upper half ; *palea* absent. *Upper floret* ♀ or ⚥ ; *lemma* 3 mm. long, cleft in the upper quarter into two triangular lobes, hyaline ; *stamens*, if present, three ; *anthers* 1·75 mm. long ; *styles* 2 ; *stigmas* plumose ; *awn* 7 mm. long ; *column* chestnut-coloured 2·5 mm. long ; *grain* 3 mm. long. *Pedicelled spikelet* ♂, elliptic-acute, 3 mm. long. *Lower glume* size and shape of the spikelet, 9-nerved, with a well-marked median nerve, smooth and glabrous, dull red ; *upper glume* similar in shape but smaller, 3-nerved. *Florets* reduced to an ovate-acute hyaline 2-nerved lemma wrapped round the stamens ; *anthers* 1·75 mm. long.

Ind. Or. : Nepal, *Wallich* no. 8794 M.

This grass appears to be rare, for it is only known from the type collection which is, itself, without a base. It is, nevertheless, a very distinct looking grass, and the short, squat, pedicelled spikelets are quite different from those in any of the species so far seen from India, Burma or Ceylon. None of the specimens outside the type collection which have been identified as *C. exsertus,* including those cited by Hook. f., is that species. Sir Joseph Hooker presumed that it was a form of *Andropogon nardus* Linn., altered by culture, but there is no evidence at all that this plant is cultivated. It has not been collected since.

18. Cymbopogon virgatus *Stapf ex Rhind* in Agric. Journ. Ind. **25**, 328 (1930).

An aromatic perennial grass from a knotty rootstock, forming tussocks. *Culms* up to 2·2 m. tall, terete, smooth, polished and shining, smooth and glabrous, sometimes hairy at and below the nodes, erect simple, often tinged with purple. *Leaf-blades* linear-acuminate, 40–60 cm. long, up to 1·5 cm. wide, (teste Rhind), flat, rigid, gradually tapering to the rounded base, long-acuminate to a fine tip, smooth on the upper surface, minutely scabrid on the lower surface, smooth on the mar-



Lower glumes of the hermaphrodite spikelets of

16. *Cymbopogon flexuosus* (Nees) Wats.; 17. *C. pendulus* (Nees ex Steud.) Wats.; 18. *C. exsertus* (Hack.) A. Camus; 19. *C. virgatus*. Stapf; 20. *C. khasianus* (Hack.) Stapf; 21. *C. distans* (Nees) Wats. All × 10.

gins below, but gradually becoming more scabrid as the tip is approached, dark green above, pale below; *culm-sheath* shorter than the nodes, smooth and glabrous or villous below, finely striate, clasping, tight, contracted at the tip to the base of the blade, auriculate, basal sheaths becoming scarious-coriaceous, shining, very pale, slipping from the culm and breaking up into fibres or becoming curled; ligule 3–4·5 mm. long, membranous to chartaceous, lacerate.

Inflorescence a panicle, usually (?) lax, loose, simple and interrupted, occasionally dense, decompound and interrupted, up to 45 cm. long; axis straight, erect, long-noded, with spathe-like sheaths at the nodes carrying immature blades or bladeless, with 1–3 long-noded branches at the nodes which rebranch once or twice or more and then end in a proper spathe supporting the peduncle and racemes; internodes of the axis and branches smooth, terete, glabrous, or more usually villous below the nodes, ultimately very slender; spatheoles narrow, linear-acute, turning red, 14–17 mm. long, many-nerved; peduncles slender, wiry, up to 7 mm. long, dilated and villous at the tip; racemes 8–12 mm. long, eventually epinastically deflexed, one subsessile the other shortly pedicelled; joints 1·5 mm. long, linear, flattened, densely ciliate on the margins, dilated above into two large teeth, which clasp the base of the sessile spikelet; pedicels equal in length but with smaller teeth above. Lowest pair of spikelets in the subsessile raceme homogamous, ♂ or neuter pedicel of the pedicelled spikelet not swollen, the remaining pairs in both racemes heterogamous. *Hermaphrodite spikelets* 4–5 mm. long, elliptic-lanceolate acute, with a short bearded callus. *Lower glume* size and shape of the spikelet, 2-keeled in the upper half and winged on the keel; many and finely-nerved between the keels, smooth and glabrous except for the scabrid keels, flat on the dorsal surface in the upper half, with a couple of depressions and 1-several wrinkles in the lower half, often slightly oblique; *upper glume* boat-shaped, rounded on the dorsal surface below, keeled in the upper half, scabrid on the keel, otherwise smooth and glabrous. *Lower floret* empty; *lemma* 3·5 mm. long, hyaline, linear-acute in shape, 2-nerved, ciliate on the margins above; *palea* absent. *Upper floret* ⚥; *lemma* very narrow, hyaline, 3 mm. long, cleft to the middle into two subulate lobes, awned in the sinus; *palea* absent; *awn* 9 mm. long; *column* dark-brown, twisted, 4 mm. long; *styles* 2; *stigmas* plumose, purple; *stamens* 3; *anthers* 1 mm. long, purple. *Pedicelled spikelet* 4 mm. long, lanceolate-acuminate, ♂. *Lower glume* size and shape of the spikelet, 5–6-nerved, smooth and glabrous, scabrid on the keels; *upper glume* 3-nerved, smooth and glabrous. *Florets* reduced to a hyaline scale 3 mm. long, ciliate on the margins above; *stamens* 3; *anthers* about 1 mm. long.

Burma: Upper Burma, Mahlaing, 17 Nov. 1928, *E. B. Minus*—growing wild in rocky parts; Mandalay Dist., Thaphangaing, 12 Nov. 1928, *D. Rhind*; Thaphangaing, near Sedaw, 100 m., 15 Feb. 1929, *D. Rhind* 926 (type in Herb. Kew.)

Although this grass is cited in the Index Kewensis as *Cymbopogon virgatus* Stapf ex Rhind in Agri. Journ. India, **25**, 328 (1930), it is not in fact described in that place, nor are any details of its botanical structure given, so that it is to all intents and purposes a nomen nudum. All that we are told is that it is a coarse perennial, tufted grass, growing in rocky places and in open forest. The culms are up to 8 ft. tall and flowering takes place in November. The crushed leaves have a very unpleasant smell.

Rhind distilled a quantity of the grass and obtained 0·55 per cent. of an unpleasant smelling oil which Messrs. Schimmel analysed. The oil is not likely to be commercially valuable.

In order to validate the name a short diagnosis in Latin follows.

Cymbopogon virgatus Stapf ex Rhind descr. ampl. Ab aliis speciebus panicula erecta, racemis brevioribus distinguenda.

Gramen perenne aromaticum. Culmi usque 2·2 m. alti, teretes, laeves, glabrique, infra nodos interdum pilosi. *Foliorum laminae* lineare-acuminatae, 40–60 cm. longae, usque 1·5 cm. latae; *vaginae* nodis breviores, laeves glabraeque vel inferne villosae; ligula 3–4·5 mm. longa, membranacea vel chartacea, lacerata.

Panicula erecta, laxa, simplex vel composita, interruptaque usque 45 cm. longa; spatheolae 14–17 mm. longae; racemi 8–12 mm. longi, demum epinastice deflexi; pedicellus infimus haud incrassatus. *Spiculae hermaphroditae*, 4–5 mm. longae, elliptico-lanceolato-acutae, callo breve barbato. *Gluma inferior* dorso plana, carinis scabra, *superior* navicularis. *Anthoecium inferius* vacuum, superius ☿; *lemma* angustum, bifidum, aristatum; *palea* abest; *arista* 9 mm. longa; *antherae* 1 mm. longae. *Spicula pedicellata* 4 mm. longa, lanceolato-acuminata.

19. Cymbopogon khasianus (*Hack.*) *Stapf ex Bor* in Ind. For. Rec. **1**, pt. 3, 92 (1938).

Andropogon nardus var. *khasianus* Hack. in DC. Monogr. Phan. **6**, 602 (1889).

A perennial grass from a rather stout rootstock. *Culms* up to 2 m. erect, terete, with a more or less dense tomentum at or below the nodes, otherwise smooth and glabrous, polished. *Leaf-blades* linear, long-acuminate, ending in a very fine membranous filiform tip, up to 60 cm. long, perhaps longer, 8 mm. broad, dark green on the upper surface, somewhat glaucous below, coarse scabrid on the margins, scaberulous on both surfaces, glabrous, rather flaccid; *sheaths* of the culms tight, clasping, becoming coriaceous, very striate, shorter than the internodes; *ligule* membranous, becoming chartaceous, rounded above, 1–2 mm. long.

Inflorescence a very large, decompound, oblong panicle, up to 90 cm. long by 30–40 cm. broad, decompound, the branches branching up to the third or fourth degree, loose or somewhat dense; axis of the panicle 8-10-noded, each in the axil of a spathe-like sheath with or without a blade, terete below, becoming 2-angled above and slightly expanded at the node, often hirsute along a line between the two nodes, hairy or glabrous at the nodes; subsidiary branches similar; spatheole 15–20 mm. long, narrowly elliptic-acute when flattened, smooth and glabrous, many-nerved, hyaline on the margins; peduncle up to 10 mm. long, hairy at the apex and carrying two racemes; racemes 1–2 cm. long, one subsessile the other pedicelled, very hairy in the fork; joints 3 mm. long, linear, 2-angled, expanding above into a 2-toothed excavation, long ciliate on the angles; pedicels very similar but shorter. The lowest pair of spikelets in the subsessile raceme homogamous, ♂, the pedicel of the pedicelled spikelet very short but not swollen or adnate, the remaining pairs of spikelets in both the racemes heterogamous. *Hermaphrodite spikelets* elliptic-acute, 4·5–5·5 mm. long, most usually suffused with purple. *Lower glume* size and shape of the spikelet, flat on the back or with several depressions, smooth and glabrous, 2-keeled from the middle upwards, with 7 intracarinal nerves, winged on the keel, scabrid on the wings, bifid at the apex; *upper glume* boat-shaped, keeled in the upper third, smooth and glabrous, scabrid on the keel, 3-nerved. *Lower floret* empty; *lemma* a hyaline, lanceolate-acute 2-nerved scale; *palea* absent. *Upper floret* ⚥; *lemma* 2·5–3 mm. long, split to the middle, awned in the sinus; *palea* absent; *awn* 10 mm. long; *column* chestnut-brown, twisted, 5 mm. long; *styles* 2; *stigmas* plumose, purple; *stamens* 3; *anthers* 2 mm. long. *Pedicelled spikelets* elliptic-acute in shape, 4–4·5 mm. long, dark brownish purple. *Lower glume* shape and size of the spikelet, many-nerved, keeled from the middle upwards, scabrid on the keels, otherwise smooth and glabrous; *upper glume* boat-shaped, 3-nerved, smooth and glabrous. *Florets* reduced to a hyaline scale wrapped round 3 *stamens*; *anthers* 2 mm. long.

Ind. Or.: Khasi Hills; towards Moflong, Nov. 1835, *Griffith* 6764 holotype of *Andropogon nardus* subsp. *khasianus* Hack.; idem 6765; Bogapanee, 29 Jun. 1850 *Hook. f. & T. Thoms.*; Syong, 4 Jul. 1855, *Hook. f. & T. Thoms.*; below Poniranga, 18 Sept. 1850 *Hook. f. & T. Thoms.*; Tserra, 1300 m., 8 Oct. 1867, *C. B. Clarke* 6432; Shillong, 1400 m., 6 Aug. 1885, *C. B. Clarke*; Shillong, 1500 m., 22 Oct. 1942, *N. L. Bor* 17153.

Naga Hills; 1935, *N. L. Bor* 1121; ibidem, *N. L. Bor* 2379; Sataka, 1900 m., 8 Sept. 1942, *N. L. Bor* 16320. Manipur; Mythi Phuni, 1100 m., 13 Nov. 1885; Thoubal, 1000 m., 19 Dec. 1942 *N. L. Bor* 16955—an aromatic grass.

var. **nagensis** Bor, var. nov. a typo spiculae sessilis gluma inferiore latiore hirsutaque, carina glumae superioris late alata recedit.

Ind. Or.: Assam; Naga Hills, Shiloi Jopi, 16 Nov. 1935, 2600 m., *N. L. Bor* 10—on dry grassy slopes.

This grass, which may yet prove to be distinct, is closest to *C. khasianus* (Hack.) Stapf, but the very broad hairy lower glume of the sessile spikelet and the winged upper glume give it a very different facies. One peculiar feature of the wing on the upper glume is that in a high percentage of mature spikelets the upper portion of the wing becomes detached and recurved as a kind of spur. Shiloi Jopi, where this grass was collected, is on the eastern boundary of the Naga Hills, and was at one time a game reserve, consisting mainly of vast grass covered slopes which were fired every year. There are, or were, a few stands of *Pinus insularis* Engl. in this area.

20. Cymbopogon distans (*Nees*) *Wats.* in Atkins. Gaz. N. W. Prov. Ind. 392 (1882).

Andropogon distans Nees ex Steud. Syn. Pl. Glum. 387 (1854).

A perennial aromatic grass with many fibrous roots. *Culms* up to 45 cm. tall, rather slender, terete, smooth and glabrous, even at the nodes, polished, erect, simple. *Leaf-blades* linear-acuminate, up to 50 cm. long, 3 mm. broad, folded, involute, twisted, finally almost filiform, glabrous, minutely scabrid on both surfaces to almost glabrous, rather glaucous; upper *sheaths* tight, clasping the culms, glabrous, very striate, most minutely scabrid, glaucous, auricled, the lower very short, coriaceous, smooth and glabrous, polished and shining, long-persistent at the base, finally breaking up into tough fibres.

Inflorescence a simple panicle made up of an axis branching once at the nodes, each branch terminated by a spatheole and peduncle carrying a pair of racemes; axis with long, terete, smooth and glabrous internodes, each internode arising in the axil of a bladeless sheath; spatheole 2·5–5 cm. long (exceptionally 5–7 cm.), narrowly elliptic-acute when flattened, greyish green, many-nerved, hyaline on the margins, compressed; peduncle 1·5 cm. long, smooth and glabrous, wiry; racemes divaricate, eventually forming a straight line, 25–35 mm. long, one subsessile, one short-pedicelled; joints 2 mm. long, stout, 2-toothed at the cup-like top, compressed, densely ciliate on the edges; pedicels 3 mm. long, 2-toothed above, ciliate. Lowest pair of spikelets in the subsessile raceme homogamous, ♂, pedicel of the pedicelled spikelet not swollen or adnate, all remaining pairs of spikelets in the two racemes heterogamous. *Hermaphrodite spikelets* 6–8 mm. long, oblong-acuminate or oblong-elliptic-acuminate without the wings, often oblique. *Lower glume* shape and size of the spikelet, 2-keeled, broadly wiry on the keel in the upper half, with three intracarinal nerves, smooth and glabrous on the flat or shallowly depressed back, bifid above, scabrid on the keels, chartaceous, shining; *upper glume* as long as the lower glume, boat-shaped, compressed and keeled above, rounded and chartaceous below, shining, smooth and glabrous, scabrid on the keel which is narrowly winged. *Lower floret* empty; lemma elliptic acuminate, 2-keeled, ciliate on the flaps, 5 mm. long; *palea* absent. *Upper floret* ⚥; *lemma* 3·5 mm. long, very narrow, cleft to the middle, awned; *palea* absent; *awn* 18 mm. long; *column* 10 mm. long; *stamens* 3; *anthers* 2·5 mm. long; *styles* 2, long; *stigmas* plumose, purple. *Pedicelled spikelets* lanceolate acuminate, 7–9 mm. long. *Lower glume* shape and size of the spikelet, many-nerved, very broad and wrapped round the upper glume, smooth and glabrous; *upper glume* as long, 3-nerved, ciliate on the margins above. *Florets* reduced to a single hyaline lanceolate-acute scale; *stamens* 3; *anthers* 3 mm. long.

Ind. Or.: Central Himalaya; Simla, 24 Aug. 1849, *T. Thomson*; Simla, Elysium Hill, 1900 m., 9 Sept. 1877, *J. S. Gamble* 4959B; Simla, Jakko, 2600 m., Sept. 1877, *J. S. Gamble* 5463A; Simla, Mahaser Rd., Sept. 1877, *J. S. Gamble* 5144A; Tehri-Garhwal, Tihri road between Landour and Phedi, 2–2300 m., Sept. 1881, *J. F. Duthie* 2154; Tehri Garhwal, Jumna valley above Bari, 2500–2900 m., 1 Oct. 1883, *J. F. Duthie* 304; Kumaon, near Bhim Tal, 1300–1500 m., 4 Oct. 1885, *J. F. Duthie* 5059; Simla, Tara Devi, 1900 m., Oct. 1889, *J. F. Duthie* 10098; Malhot, 1500 m., Nov. 1891, *J. S. Gamble* 23262; Jaunsar, near Chakrata, 2300 m., Oct. 1894, *J. F. Duthie* 15147; Jaunsar, Matkangra, 2300 m., Oct. 1894, *J. S. Gamble* 25006; Tehri Rd. below Landour, 2–2300 m., 25 Sept. 1895, *J. F. Duthie* 17839; Mussoorie, 2300 m., Sept. 1898, *J. S. Gamble* 27222; Mussoorie, Witches Hill, 2000 m., 3 Sept. 1930, *R. R. Stewart* 11406; Simla Hills,

Kasauli, 2000 m., 5 Nov. 1933, *R. N. Parker* 3277—an aromatic grass, the inflorescence more or less lemon-scented. The scent varies a good deal from one plant to the next. The dominant grass on dry rocky hot slopes between 3000 and 4000 feet. It is not much eaten by cattle.

N.W. Himalaya; Kashmir, Murru, 2000 m., 11 Oct, 1875, *Levinge*; Mattiana, 1885, *J. R. Drummond* 21103; Kashmir, Sandrattan, Sept. 1874, *C. B. Clarke* comm. 24182A; Bashahr, Karchang Bridge, 2000 m., 6 Oct. 1890, *J. H. Lace* 633; Malkandi, Kagan, *J. F. Duthie* 22655; Chamba, Pangi, 2600 m., 8 Aug. 1899, *Harsukh*; Nathia, 1907, *Sir H. Deane*; Kashmir, Banihal pass, 2000 m., 5 Sept. 1930, *R. R. Stewart* 10171; *Col. G. Wingate.*

Beyond the fact that this grass contains an aromatic lemon-scented substance in its tissues, nothing is known of it as a source of oil.

21. Cymbopogon thwaitesii (*Hook. f.*) *Bor*, comb. nov.

Andropogon thwaitesii Hook. f. in Trimen, Flor. Ceyl. 243 (1900).

A. distans Thw. Enum. Pl. Zeyl. 364 (1864) non Nees.

A perennial grass from a woody rootstock. *Culms* simple, over 1 m. tall, erect from the base, terete, smooth, polished, glabrous; *internodes* long above, crowded below. *Leaf-blades* linear-acuminate, long attenuate to a filiform tip, narrowed to and almost petiolate at the base, up to 21 (35 cm. *fide* Hook. f.) cm. long, 4 mm. broad, flat, minutely scaberulous but glabrous on both surfaces, with two small triangular glandular patches, one on each side of the narrowed base; *sheaths* at the base very crowded, overlapping, very broad below, smooth and glabrous, very striate, scarious on the margins, loose, auriculate, those of the culm proper shorter than the internodes, tight at first, eventually becoming looser and slipping from the internodes, smooth and glabrous, very striate; *ligule* continuous with the auricle, up to 5 mm. long, truncate, becoming coriaceous.

Panicle an almost simple raceme of pedunculate spatheate raceme-pairs about 15 cm. long, 2–3 cm. broad, loose, not congested; internodes of the rhachis wiry, slightly thicker above, somewhat compressed, smooth and glabrous, or sparsely ciliate on the edges and bearded just below the node; spatheoles narrowly elliptic-acuminate about 35 mm. long, very striate, hyaline on the margins, turning brownish-red at maturity; peduncle about 10 mm. long, wiry, expanded at the tip; racemes 15–22 mm. long, one subsessile, the other shortly pedicelled, hairy in the fork; joints of the racemes 3·5 mm. long, slender, linear, compressed, expanded above into a toothed cup, ciliate on the edges and on the outer surface; pedicels very similar. Lowest pair of spikelets in the subsessile raceme homogamous, ♂ or neuter, pedicel of the pedicelled spikelet of this pair, short, stout, but not markedly thickened, all other pairs of both racemes heterogamous. *Hermaphrodite spikelet* lanceolate-acute, elliptic-acuminate, 6–8 mm. long, 1–1·5 mm. broad, with a shortly bearded callus. *Lower glume* shape and size of the spikelet, 2-keeled, flat on the back or puckered or shallowly concave, narrowly winged on the keels, shortly cleft at the apex, smooth and glabrous on the dorsal surface, scabrid on the margins of the wings, 3- or more-nerved between the carinals; *upper glume* as long as the lower glume, boat-shaped, 3-nerved, keeled and narrowly winged on the keel in the upper half. *Lower floret* empty; *lemma* a lanceolate-acuminate hyaline scale, 5–5·5 mm. long, 3-nerved; *palea* absent; *upper floret* ☿; *lemma* very narrow, split for half its length into two linear, narrow, ciliate lobes awned in the sinus; *palea* an oblong, bifid scale, ciliate on the margins, very short; *awn* 13 mm. long; *column* brown, twisted, 6 mm. long; *styles* 2, long; *stigmas* plumose; *stamens* 3; *anthers* 3 mm. long; *lodicules* 2, quadrate, minute, 2-toothed. *Pedicelled spikelet* 7 mm. long, narrowly elliptic-acuminate. *Lower glume* shape and size of the spikelet, convex on the back, very many-nerved; *upper glume* rounded on the back, 3-nerved, ciliate on the margins above. *Florets* reduced to an oblong-elliptic-acute 3-nerved scale, ciliate on the margins; *stamens* 3; *anthers* 3·25 mm. long, dark red in colour; *lodicules* 2, small.

Ceylon: Newara Eliya, Aug. 1862, *Thwaites* C. P. 3784 (type at Kew); Hakgala Bot. Garden, Hakgala Peak, c. 2000 m., 16 Dec. 1950, *F. Ballard* 1110—near base of Peak, in open part of wet jungle.

The above description is taken from Thwaites' type sheet. There is a note on this sheet in Hooker's handwriting to the effect that the specimen was lemon-scented. The specimen collected by Ballard at Hakgala seems to be this species. It is, however, a far more robust grass which, unfortunately, is without its basal parts. Against this, however, the leaves are strongly petioled, the ligule is long and the sessile spikelets are acuminate but only 5·5–6 mm. long. In this specimen the panicle is extremely long, over 45 cm., and is about 5 cm. broad, the leaves, too, are much longer than those in Thwaites' specimen, being up to 65 cm. long by 12 mm. broad. Apart from the size, there is no single or group of characters which would justify its being raised to specific rank, and it may well be that Thwaites' specimens were collected in an unfavourable habitat. The leaves of this specimen smell strongly of lemon.

22. Cymbopogon coloratus (*Nees*) *Stapf* in Kew Bull. **1906,** 321 (1906).

Andropogon coloratus Nees in Wight, Cat. no. 1703 (1833) nomen nudum.

A. nardus Linn. var. *coloratus* Hook. f. Flor. Brit. Ind. **7**, 206 (1896); description.

A. nardus Linn. subsp. *glomeratus* Hack. in DC. Monogr. Phan. **6**, 604 (1889).

A perennial aromatic grass, caespitose from a short thick rootstock. *Culms* simple, over 1 m. tall, erect or hardly geniculate at the base, terete, smooth, polished, glabrous apart from a furry pubescence about the nodes. *Leaf-blades* linear-acuminate, long-attenuate to a filiform tip, up to 40 cm. long and possibly longer, 4–6 mm. broad, green or somewhat glaucous in colour, eventually turning red or reddish with age, minutely scabrid on both surfaces, coarsely scabrid on the margins, rather rigid; *sheaths* very rigid, very striate, leathery, smooth and glabrous apart from a furry pubescence towards and at the nodes and on the exterior margin, eventually almost glabrous, those of the lowest nodes very loose, leathery, shining, glabrescent, polished, falling away from the culm, those at the base finally woolly ; *ligule* chartaceous, rounded above, 1–2 mm. long.

Inflorescence a narrow, erect panicle 30 cm. and more long, up to 4 cm. broad, usually interrupted, occasionally congested but never widely spreading ; the divisions short, dense ; internodes of the axis straight, wiry, becoming thicker above, usually furry-pubescent at and below the nodes, often pubescent along a line between the nodes ; spatheole 14–16 mm. long, narrowly elliptic-acute, turning a brownish-red at maturity ; peduncle about 2 mm. long, clavate, smooth and glabrous ; racemes 12–14 mm. long, one short-pedicelled or subsessile, the other long-pedicelled, very hairy in the fork ; joints of the raceme 2 mm. long, expanded above into a 2-toothed excavation, long-ciliate (cilia 2–3 mm. long) on the edges ; pedicels similar, slightly shorter. Lowest pair of spikelets in the subsessile raceme homogamous, ♂, with the pedicel of the pedicelled spikelet grotesquely swollen, the remaining pairs of spikelets heterogamous. *Hermaphrodite spikelets* apart from the wings elliptic-acute, 5–6 mm. long, 1 mm. broad, with a short bearded callus. *Lower glume* shape of the spikelet, 2-keeled, irregularly winged on the keels, not nerved between the conspicuous brown keel-nerves, flat on the back above, in the lower half with a shallow groove or the groove broken up into 2–3 shallow depressions or wrinkles ; smooth or glabrous or minutely puberulous in the lower half, scabrid on the keels ; *upper glume* as long as the spikelet, boat-shaped, keeled above, smooth, shining and glabrous on the dorsal surface, scabrid on the keel, 3-nerved. *Lower floret* empty ; *lemma* a hyaline scale 4·5 mm. long, 2-nerved, with ciliate flaps in the upper half ; *palea* absent. *Upper floret* ⚥ ; *lemma* very narrow, hyaline, 3 mm. long, split to the middle into two linear ciliate lobes, awned in the sinus ; *palea* absent ; *stamens* 3 ; *anthers* 1·5 mm. long ; *styles* 2 ; *stigmas* plumose ; *awn* 13 mm. long ; *column* 5 mm. long. *Pedicelled spikelets* 4·5–5 mm. long, lanceolate-acuminate, ♂. *Lower glume* shape and size of the spikelet, 2-keeled in the upper half, rounded below, membranous, many-nerved, scabrid on the keels ; *upper glume* shallowly boat-shaped, 3-nerved, smooth and glabrous below, somewhat scabrid and minutely puberulous above. *Florets* reduced to a hyaline scale ; *stamens* 3 ; *anthers* 1·5 mm. long.

Ind. Or. : Madras State ; Herb. Wight. 1703 (Typus in Herb. Kew.); Salem, Devarbetta 25 Feb. 1927, *K. Cherian Jacob* 18052; Anantapur Dist., Penukonda, 12 Feb. 1917, Madras Herb. no. 14322 ; Cuddapah Dist., 1917, *R. S. Hole*, Dehra Dun, legit ; Cuddapah Balleipalle, 300 m., Feb. 1883, *J. S. Gamble* 11195 ; North Arcot Dist., Chandragiri, 23 Feb. 1914, Madras Herb. no. 10000 ; ibidem, Kuppam, 19 Dec. 1927, *H. E. Watson* ; Herb. Heyne, *Wallich* 8794B ; Bellary, Tumati, Oct. 1889, *J. S. Gamble* ; ibidem, Malpanguda, Oct. 1889, *J. S. Gamble* ; Herb. Wight. 3087 ;

Madhya Pradesh ; Chanda Dist. ; *J. F. Duthie* 9893.

In the type folder of *Cymbopogon coloratus* (Hook. f.) Stapf at Kew the following sheets are to be found.

(1) Two sheets of Wight's catalogue number 1703, distributed under the name *Andropogon coloratus* Nees, which appears to have been a manuscript name only. The plants on the two sheets are identical and are of a

short erect grass with a narrow interrupted panicle of rather dense congregations of raceme pairs, the reds and brown of the spatheoles and spikelets contrasting with the silver grey, rather long hairs on the joints and pedicels.

The first time a description of the plant was published was in 1896, when Hook. f. in the Flora of British India distinguished it as a variety of *Andropogon nardus* Linn. with a brief diagnosis.

(2) Two sheets of Wight's catalogue number 1700 c, which was distributed under the name *Andropogon* (*Cymb.*) *caesius elatior, culmo erecto firmo*, Stapf considered them to be a similar form to *A. coloratus* Nees, ' but with long, stiff and dense panicle and paler spathes '. This grass is so similar to *C. flexuosus* that identical specimens have been placed under *C. flexuosus* and under *C. coloratus*. The position of the grass seems to be intermediate between *C. coloratus* and *C. flexuosus*, and actually is the species described as *C. travancorensis* in this paper.

The oil obtained from this grass is said to resemble a mixture of the oils of lemon-grass and citronella. At the Imperial Institute the chief constituents were identified as geraniol and citronellal. On the other hand, Pilley, Rao & Simonsen [Jour. Soc. Cham. Ind. **47**, 52 (1928)] obtained an entirely different oil from the flowery tops of a grass said to be this species. It contained geraniol, sesquiterpenes, borneol, limonene, camphene, etc. This result shows that there is some doubt about the identity of the grasses used. The presence of borneol suggests that *C. travancorensis* Bor, either pure or in mixture with grasses strongly resembling it, was used in the latter experiment, since it is the only *Cymbopogon* with borneol as one of the constituents of its oil. There is the possibility, however, that *C. coloratus* also possesses this substance in its oil, since, as will be seen from the remarks under *C. travancorensis* Bor, there is much else in common between the two species.

23. **Cymbopogon travancorensis** *Bor*, sp. nov. *C. flexuoso* (Nees) Wats. persimilis sed ab eo nodis barbatis, pedicello infimae spiculae pedicellatae racemi subsessilis crasso distinguenda.

Gramen perenne. *Culmi* erecti, usque 2·5 m. alti, validi, teretes, laeves glabrique, nodis barbati. *Foliorum* laminae usque 1 m. longae, lineares, acuminatae, in apicem filiformem attenuatae; *vaginae* laeves, glabrae, laxae; *ligulae* chartaceae demum coriaceae, 1–1·5 mm. longae.

Panicula terminalis magna, *C. flexuosi* paniculae persimilis sed racemi haud congesti; racemi circa 1 cm. longi; articuli lineari-clavati, 2·5 mm. longi, compressi, marginibus ciliati; pedicelli similes; racemi subsessilis par imum inferius homogamum, ♂ vel neutrum, alia spicularum paria heterogama; spiculae sessiles ⚥, pedicellatae ♂. *Spiculae sessiles* 3·5–4 mm. longae. *Gluma inferior* elliptico-acuta, bicarinata, carinis alata, obscure nervata; *gluma superior* navicularis, apiculata, carinata, laevis, glabra. *Anthoecium inferius* vacuum, *lemma* hyalinum, oblongo-acutum; *palea* abest. *Anthoecium superius* ⚥; *lemma* lineare, bifidum, ex fissura aristam perfectam 12 mm. longam emittens; *styli* 2; *stigmata* plumosa; *stamina* 3; *antherae* 2 mm. longae; *caryopsis* 3 mm. longa. *Spicula pedicellata* ♂, 3·5 mm. longa, elliptico-acuta. *Gluma inferior* elliptico-acuta, bicarinata, carinis scabra, 5-nervis; *gluma inferior* navicularis, 3-nervis, carina apicem versus scabra, ceterum laevis glabraque; *lemma* hyalinum, 3 mm. longum; *stamina* 3; *antherae* 1·5–1·7 mm. longae.

Cymbopogon travancorensis *Bor*, sp. nov.

An aromatic perennial. *Culms* erect, up to and probably over 2·5 m. tall, up to 1 cm. thick at the base, very stout, solid, terete, smooth and very glabrous, polished, except at the nodes which are often covered with a short golden pubescence, simple. *Leaf-blades* in robust specimens up to and over 1 m. long, up to 2 cm. broad, linear in the middle portion, tapering to both ends, (the lower leaves almost all midrib at the base), and ending in a very long drawn-out attenuate tip, scaberulous on both surfaces, very coarsely scabrid on the margins, somewhat glaucous on the lower surface, glabrous on the lower surface except for a white tomentum of short hairs on the glandular patches at the base, covered in the basal part of the upper surface with a dense covering of long white hairs which are particularly dense behind the ligule, sometimes tinged with purple; *lower sheaths* coriaceous, shiny, white, polished, very loose and showing a distinct tendency to slip from the culm and form spirals just as in *C. jwarancusa*, the *upper sheaths* tight, clasping the culms, smooth and glabrous, striate, sometimes tinged with purple; *ligule* chartaceous or coriaceous, 1–1·5 mm. long.

Inflorescence a terminal decompound panicle of many raceme-pairs, with the aspect of a panicle of *C. flexuosus*; axis grooved on the side from which the branch springs, otherwise terete, very smooth and glabrous, polished, with branches branching and rebranching with very short branchlets; branchlets grooved or flattened on one side, clavate towards the apex and there hairy, otherwise smooth and glabrous; spatheole about 10 mm. long, drying reddish-brown, narrowly lanceolate- or elliptic-acute, striate, hyaline on the margins, glabrous, minutely scaberulous; peduncle 3 mm. long, filiform, clavate at the tip, smooth and glabrous; raceme-pairs about 1 cm. long, one subsessile, one shortly pedicelled; joints of the racemes about 2·5 mm. long, linear-clavate, ending above in a toothed cup, convex on one surface, flat or slightly concave on the other, ciliate on the margins and villous on the concave surface; pedicel similar. Lowest pair of spikelets in the subsessile raceme homogamous, ♂ or neuter, pedicel of the lowest pedicelled spikelet grotesquely swollen and adnate to the joint, the remaining pairs of spikelets in both racemes heterogamous. Lowest pair of spikelets in the subsessile raceme heteromorphous, the sessile resembling a hermaphrodite spikelet of *C. flexuosus*, but with rather broader wings. *Hermaphrodite spikelet* 3·5–4 mm. long, without the wings elliptic-acute, with a short bearded callus. *Lower glume* shape and size of the spikelet, 2-keeled, winged in the upper half of the keels, (wings ending just below the tip) without any obvious nerves apart from the keel nerves, smooth and glabrous, with one or two depressions in the lower half on the back; *upper glume* boat-shaped, 1-nerved, keeled in the upper half, narrowly winged on the keel, scabrid on the wing, otherwise smooth and glabrous. *Lower floret* empty; *lemma* a hyaline nerveless scale 3·5 mm. long, oblong-acute in shape; *palea* absent. *Upper floret* ☿; *lemma* very narrow, 2·5 mm. long, split to the middle, awned; *palea* absent; *awn* 12 mm. long; *column* 5 mm. long, brown, twisted; *styles* 2; *stigmas* plumose; *stamens* 3; *anthers* 2 mm. long; *grain* 3 mm. long; *embryo* almost half as long; *hilum* a dark coloured basal point. *Pedicelled spikelet* ♂, 3·5 mm. long, elliptic-acute. *Lower glume* shape and size of the spikelet, weakly keeled in the upper half, scabrid on the keels, 5-nerved, rounded on the back, smooth and glabrous ; *upper glume* boat-shaped, 3-nerved, scabrid on the keel near the tip, otherwise smooth and glabrous. *Florets* reduced to a hyaline scale 3 mm. long which encloses 3 *stamens* with *anthers* 1·5–1·7 mm. long.

Ind. Or.: Madras ; Wight's Cat. 1700C ; Slopes of the Pulneys, 3–600 m., *Barber* 6588, 2640 and 2641 ; Munanthorai Ghat, Tinnevelly, 14 May 1901, *C. A. Barber* 2769 ; Koilpatti, 19 July 1901, *C. A. Barber* 3437 ; Courtallam, Tinnevelly, 11 Nov. 1908, *Bourne* 5309 (typus in Herb. Kew.) ; ex Imperial Institute 16 Aug. 1923, received as *C. flexuosus* ; Poonachi Ghat, Annamallais, 8 Oct. 1901, *C. A. Barber* 3582 : Travancore ; hills near Shencotta, 200 m., 26 Nov. 1914 ; *Venkoba Rao* ; Nadarai, 1 Nov. 1904, *C. A. Barber* 6739 ;

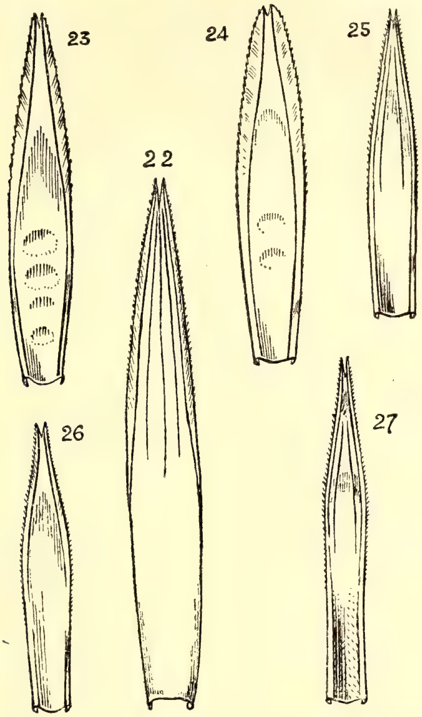
In addition to the above, there are at Kew 8 sheets of a grass received from the Imperial Institute as the white variety of Lemon-grass. Stapf identified these gatherings from Travancore as *C. flexuosus* forma *albescens*, but they are all different from *C. flexuosus* in the swollen lowest pedicel in the subsessile raceme. Superficially, the panicles and spikelets are those of *C. flexuosus*.

C. travancorensis, according to Venkoba Rao, is known in its native home by the names Inchi, Inchippul or Sukhunarippul, but as Guenther remarks, l. c. 133, there is considerable confusion in the literature regarding the taxonomy of the grass from which Inchi-grass oil is obtained. It is quite obvious that no reliance can be placed on local names, since the same name is often given to species with a superficial resemblance to one another. Unless, therefore, the chemists who are investigating the properties of a minor forest product are also competent botanists, a remote contingency, they are likely to be at the mercy of the locals and to accept as correct what the latter decide to tell them, very often with the result that their conclusions are based on a wrongly named plant. This is what happened, one assumes, when attempts to arrive at a correct name for Inchi-grass were made.

In a paper in the *Perfume and Essential Oil Record* **13**, 292 (1922), Moudgill and Iyer describe the extraction and properties of Inchi-grass oil. One is led to believe from the title of the paper that the grass they were dealing with was *C. caesius*, but the paper concludes with a paragraph on the identification of Inchi-grass, which is reproduced here.

' *Note on the Identification of Inchi Grass.* A sample of the grass was sent to Rao Bahadur K. Rangachariar of Coimbatur, through his assistant, Mr. Tadulinga Mudaliar. They stated that the white variety was *Cymbopogon caesius*, Stapf, and the red variety *Cymbopogon flexuosus*, Stapf. In the meantime, the Director of Royal Botanic Gardens, Kew, to whom a sample had been forwarded through the Director of the Imperial Institute, reported that both the red and white varieties were different states of the grass which he identified as *Cymbopogon flexuosus* Stapf forma *albescens*. According to this it is of interest to note that although botanically lemon-grass and " inchi "-grass are very closely allied, the oils which they yield are so entirely different. Fresh samples of both varieties of inchi-grass and lemon-grass are being sent for further identification. The identification of Rao Bahadur Rangachariar has been adopted provisionally till the final decision on this point is obtained.'

The research carried out by Moudgill and Iyer was thus left in a very unsatisfactory state, since the identity of the plant to which their published data relate, had not been established. The fresh samples, mentioned in the above paragraph, as about to be sent for identification, cannot be traced, at least in the material at Kew, and it is not known if the identification has ever been published.



Lower glumes of the hermaphrodite spikelets of

22. *Cymbopogon thwaitesii* (Hook. f.) Bor; 23. *C. coloratus* (Nees) Stapf; 24. *C. travancorensis* Bor; 25. *C. jwarancusa* (Jones) Schult. 26. *C. schoenanthus* (Linn.) Spreng.; 27. *C. parkeri* Stapf. All × 10.

Moudgill and Iyer stated that their investigations were concerned with the white variety of a grass which existed in two states, a white and a red. The red state was identified at Kew as *C. flexuosus* and the white state as *C. flexuosus* forma *albescens.* Although a glance at the spikelets of *C. caesius* would separate it from white Inchi-grass, it would be easy on account of its glaucous colour, for the non-expert to confuse the two.

There is ample evidence that the grass with which we are concerned is the grass named by Stapf *C. flexuosus* forma *albescens*, the specimen sent to Rangachariar, obviously having been collected in error for the other.

This grass is said to grow wild in profusion on the dry hill slopes of South Travancore. Fires pass over these dry hills in the spring, and the grass is invariably destroyed. The young shoots appear just after the rains in June, and reach a height of 6 ft. or so, producing flowers at the end of the year. Moudgill and Iyer state that the same grass growing in moist places or in water-logged tracts, is almost odourless, and presume that the essential oil present decreases when the habitat is wet. Until a specimen of the grass from wet areas has been examined and identified, it would be dangerous to assume that it is the same species.

Apparently the distillation of the grass for its oil, which was a regular practice at the beginning of the century, had by 1922 been entirely given up. The authors carried out an investigation into the properties of Inchi-oil in order to find out whether it could be profitably produced as a perfume oil. It was found, and the conclusions were confirmed by the Imperial Institute, that the constants of the oil differed from those of any of the oils of commerce. In fact, the oil is so different from that obtained from the grass it most closely resembles morphologically, *C. flexuosus*, that it is most surprising that the grass was not suspected of being a different species. Lemon-grass oil (from *C. flexuosus*) is characterised by the presence of citral. This substance is absent from Inchi-grass oil, whose main constituent is the alcohol borneol, which in its turn is not found in Lemon-grass oil.

Inchi-grass oil has a very pleasant odour of ginger, and it is considered that it may be used as a substitute for palmarosa oil but the yield is very low.

Attention may be drawn here to the fact that *C. travancorensis* possesses certain characters which indicate that it occupies an intermediate position between *C. coloratus* and *C. flexuosus*. In common with *C. coloratus* it has bearded nodes, and the swollen pedicel in the lowest pair of spikelets in the subsessile raceme. It resembles *C. flexuosus* in the shape of its spikelet, its stature, and above all, in its panicle. Indeed, one would hazard a guess that it is a hybrid between the two, if there was any evidence that the areas of distribution of each overlapped. These areas may, of course, impinge upon one another, but so far the collections seem to show that they do not. Another point which may be mentioned is that the oil obtained from *C. travancorensis* contains borneol, a substance which is also said to be contained in the oil derived from *C. coloratus*. There is, obviously, here room for much more investigation and research.

24. **Cymbopogon jwarancusa** (*Jones*) *Schult.* Mant. **2**, 458 (1824).

Andropogon jwarancusa Jones in Asiat. Res. **4**, 109 (1795).

A. himalayensis Gandoger in Bull. Soc. Bot. Fr. **46**, 421 (1899).

A perennial aromatic grass with a stout rhizomatous rootstock. Culms up to 120 cm. tall but usually only about half that height, with very short internodes at the base, and hence many overlapping sheaths, smooth and glabrous, terete, shining, wiry above. *Leaf-blades* flat, rarely filiform, linear, up to 30 cm. or more long, 5 mm. broad, glabrous on both surfaces, scabrid or smooth on both surfaces, very scabrid on the margins, rather firm, often coriaceous in texture; *sheaths* of the culms smooth and glabrous, tight, clasping, striate, shorter than the internodes, those of the base closely crowded, eventually, when withered, flattening out and becoming coiled like wood shavings, often turning pale yellowish-red; *ligules* membranous, becoming chartaceous, 2–3 mm. long.

Inflorescence a panicle of more or less racemosely arranged pairs of racemes seated on a peduncle supported by a spathe, 10–20 cm. long; one to several of which arise in the axil of a topmost sheath, proper spathes 2·5 cm. long, smooth and glabrous, shining often turning reddish, very narrow ; racemes 1·4–2 cm. long, one sessile or short-, the other longer-pedicelled ; joints of the racemes 2·5 mm. long, slender, expanding at the tip into a toothed cup, ciliate with hairs up to 5 mm. long ; pedicel similar but shorter, 1·5 mm. long ; pairs of spikelets in both racemes all heterogamous, except the lowest pair which are homogamous, ♂ or neuter, the pedicel of the pedicelled spikelet of this pair very short, compressed, but not swollen. *Sessile spikelet* linear- or narrowly elliptic-acuminate, straight or oblique at the tip, 5 mm. long. *Lower glume* shape and size of the spikelet, concave between the keels, 4-nerved, bifid at the apex, with the narrowest of wings on the keels in the upper half, scabrid and shortly ciliate on the keels, otherwise smooth and glabrous ; *upper glume* 4·5 mm. long, boat-shaped, compressed and keeled in the upper half, rounded below, smooth and glabrous on the dorsal surface, scabrid on the keel, 3-nerved, the mid nerve produced as a very short awn. *Lower floret* empty ; *lemma* a hyaline, 2-nerved scale, ciliate on the margins, lanceolate-acute in shape, 4 mm. long ; *palea* absent. *Upper floret* ☿ ; *lemma* 3 mm. long, hyaline, split to the middle into two narrow ciliate lobes ; *awn* 10 mm. long, hardly differentiated into column and bristle ; *styles* 2 ; *stigmas* plumose ; *stamens* 3 ; *anthers* 2 mm. long ; *lodicules* 2, truncate-cuneate. *Pedicelled spikelets* 5·5 mm. long, ♂, oblong-elliptic-acuminate. *Lower glume* shape and size of the spikelet, convex on the dorsal surface 2-keeled, 9-nerved between the keels, smooth and glabrous save on the scabrid keels ; *upper glume* shape of the spikelet, shallowly boat-shaped, 3-nerved, ciliate on the margin above, smooth and glabrous. Lower and upper florets represented by a single lanceolate-acute scale 5 mm. long ; *stamens* 3 ; *anthers* 2 mm. long.

Ind. Or. : Assam ; Goalpara, 11 Dec. 1912, *R. S. Hole.*

Bengal; Dr. Roxburgh ex Herb. Forsyth (type of *Andropogon jwarancusa.*)

Uttar Pradesh ; Bed of Jumna, near Singhoree, 8 May, 1836, *Falconer* ; ab Agra ad Saharanpur, 1831, *Jacquemont* 352 ; without locality, 8 July 1848, Forests North Oudh, 1870, *R. Thompson* ; Hardwar 1848, *Wallich* 8793D ; Gorakhpur, 26 Mar. 1898, *J. F. Duthie* 22892 ; Marka, Pilibhit, 23 Mar. 1898, *J. F. Duthie* 22891 ; Lachmipur, Gorakhpur, 15 Apr. 1898, *Harsukh* s.n.

Tehri Garhwal; Kumaon, Tons valley, *Jacquemont* 398 ; Kumaon, May 1848, *T. Thomson* ; Kumaon, Almora, 1500 m. 1846 (?), *Strachey & Winterbottom* 5 ; T. Garhwal, banks of Tons, Thadyar, 1000–1300 m., 17 May 1893, *J. F. Duthie* 12922 ; ibidem, May 1894, *J. F. Duthie* 24752 ; T. Garhwal 1300 m., May 1895, *J. S. Gamble* 25444 ; T. Garhwal, Tons valley near Thadyar, 13 May 1894, *J. F. Duthie* 14499 ; ibidem, Tons valley, 5 May 1893, *J. F. Duthie* 15579 ; ibidem, 11 May 1897, *J. F. Duthie* 19790 ; Garhwal Div., Bijrani, 9 Jun. 1902, *Inayat* 26012.

Chitral; Warai, 1400 m., 10 Sept. 1895, from Bot. Dept. N. India, 17609.

Punjab ; Ferozepore, *Griffith* 6770 ; Lahore, Mar. 1846, *Royle*; Panjab, *T. T. Thomson* 1848 ; Lahore, *Hook. f. & T. Thomson* ; Punjab, July 1870, *J. E. T. Aitchison* 97 ; Punjab, *Griffith* ex Herb. Lemann ; D. I. K., Tank, 9 May 1888, *J. F. Duthie* 7224; Multan, *J. F. Duthie* s. n. ; near Lahore, *Dr. Stewart* ; Kulu, Katrain, 1500 m., Apr. 1919, *Walter Koelz* 1882—dry slopes ;

Rawalpindi, 600 m., Sept. 1828, *R. R. Stewart*, 10155, and the following sheets of *J. F. Drummond* ; from Hissar 15241, 21099, 21100 ; Sirsa 21096 ; Tila gojian wala 21125 ; Jhelum 15102 ; Galenwala 14587 ; Chantala 21101 ; Malakwal 14753.

West Himalaya; Mohand Pass, Oct. 1890, *J. F. Duthie* s.n. ; Waziristan, Kajuri Kach, 800 m., *J. F. Duthie* 15738 ; Hindu Bagh, Shula Kila, *J. F. Duthie* 19041 ; Baluchistan, Fort Sandeman, *J. F. Duthie* 19046 ; Spiti, *Lace* 295 ; Leh, 3000 m., 12 May 1848, *T. Thomson* ; Kalatze to Nurla, Indus valley, 8 July 1848, *T. Thomson.*

This species is probably more widespread than any of the other Cymbopogons (with the exception of *C. martinii*), at least of those in the area under consideration. It ranges over the whole of northern India from Assam to Baluchistan, and is particularly common in areas of low rainfall and high temperatures. It is entirely absent from Central India, Madras and Ceylon.

The yield of oil is low, but it is quite different from any of the others. It has an odour of peppermint and consists mainly of dl-piperitone, which may amount to 77 per cent., and a lesser quantity of Δ^4 carene. There is also present in varying amounts a sesquiterpene alcohol with a rose-like odour.

It will be noted that this oil is quite different from that distilled from *Cymbopogon schoenanthus*, the species which it most closely resembles morphologically.

The specific name of the species is derived from two Indian words ; jwar—fever ; ankus—a hooked instrument used by the mahut for controlling his elephant; the combination referring to the supposed medicinal properties possessed by the grass in combating malaria. It was, and is, considered by the village people to be a very powerful remedy for all kinds of fevers. Blane, who discovered the plant, thus describes it :—' The whole plant has a strong aromatic odour, but both the smell and the virtues reside principally in the husky roots, which in chewing, have a bitter, warm, pungent taste, accompanied with some degree of that kind of glow in the mouth which cardamoms occasion'.

25. **Cymbopogon schoenanthus** *(Linn.) Spreng.* Pug. **2**, 15 (1815).

Andropogon schoenanthus Linn., Sp. Pl. ed. 1, 1046 (1753).

A. laniger Desf. Fl. Atl. **3**, 379 (1800).

A. jwarancusa subsp. *laniger* (Desf.) Hook. f. Flor. Brit. Ind. **7**, 203 (1896).

A perennial caespitose grass. *Culms* erect, slender, terete, simple, smooth and glabrous. *Leaf-blades* filiform, wiry, flexuous, semi-terete, rounded on the back, channelled on the upper surface, up to 30 cm. long by 2 mm. wide, those of the culms sometimes flatter and shorter, glabrous, minutely scabrid on the nerves on the under surface, pale, smooth ; *sheaths* of the culms smooth, glabrous, tight, those at the base much wider and looser, slipping from the culms, long-persistent, straw-coloured ; *ligules* membranous becoming firmer, scarious, oblong-truncate, 2–3 mm. long.

Inflorescence a narrow panicle up to 30 cm. long, 4–7-noded ; axis slender, smooth and glabrous, the internodes decreasing in length towards the top, sheathed in spathe-like sheaths which have only a rudimentary blade or none at all, often tinged with purple : spatheoles narrowly elliptic-acute or -acuminate ending in a setaceous point, 3–5 cm. long, many-nerved, hyaline on the margins, pale or straw-coloured ; peduncle wiry, filiform, angled or terete, widened upwards, shortly villous below the racemes ; racemes 15 mm. long, divaricate, ultimately epinastically deflexed, white-villous, often tinged with purple, one subsessile the other shortly pedicelled ; joints of the racemes 2 mm. long, compressed, 2-angled, long-ciliate on the angles, with hairs up to 3·5 mm. long, slightly widened upwards, ending in an oblique cupular tip, 2-toothed on the margins ; pedicels similar in shape and length but more slender. Lowest pair of spikelets in the subsessile raceme homogamous, ♂ or neuter, pedicel of the pedicelled spikelet shorter and broader than the others but not grotesquely swollen, hairy, all other pairs of spikelets of both racemes heterogamous. *Fertile spikelets* elliptic-lanceolate, more or less acuminate, 4–5 mm. long, with a short bearded callus. *Lower glume* shape and size of the spikelet, shallowly concave on the back, 2-keeled on the upper half, scabrid on the keels, smooth and glabrous on the dorsal surface ; *upper glume* equal in length, 3-nerved, boat-shaped, rounded on the dorsal surface below, keeled in the upper half, scabrid on the keel, ciliate on the margins above. *Lower floret* empty ; *lemma* a hyaline scale 4 mm. long, oblong-acute ; *palea* absent. *Upper floret* ⚥ ; *lemma* a linear hyaline narrow scale, cleft at the top into two subulate lobes, awned in the sinus ; *palea* absent ; *awn* 10 mm. long ; *column* brown, 3 mm. long, twisted ; *styles* 2 ; *stigmas* plumose ; *stamens* 3 ; *anthers* 1·5 mm. long. *Pedicelled spikelets* narrowly oblong-elliptic-acute, 4·5 mm. long, ♂. *Lower glume* shape and size of the spikelet, 2-keeled in the upper half, scabrid on the keels, strongly nerved, apart from the keel and median nerve 4 intracarinal nerves, smooth and glabrous ; *upper glume* as long, 3-nerved, minutely puberulous on the dorsal surface or glabrous. *Florets* reduced to a hyaline scale 4 mm. long, 2–3-nerved, ciliate on the margins in the upper half, wrapped round the three stamens ; *anthers* 1·5–3 mm. long.

Ind. Or.: Punjab: Kurram valley, Para Chenar, 23 Apr. 1894, *Harsukh* 14800; Multan, Sept. 1891, *A. V. Monro*; Ludhiana, Apr. 1837, *Edgeworth*; Salt Range, Bhirpur, Sept. 1872, *J. E. T. Aitchison* 59—not very common : highly scented grass ; Jhelum, *J. E. T. Aitchison* 157 ;

Kashmir; Astor valley, 1900 m., 28 July 1892, *J. F. Duthie* 12301; Mir Kassen Tangi, Apr. 1893, *J. F. Duthie* s.n. ; Hazara, Malkandi, Kagan, 3 Aug. 1899, *Inayat* s.n. ; Gilgit, Netta valley near Nomal, 1600–1900 m., 3 Aug. 1892, *J. F. Duthie* 12335 ; Ramoo, 10 July 1876, *C. B. Clarke* 28501A ; Baltistan, near Skardu 2600 m., 14 July 1892, *J. F. Duthie* 12045 ; Gilgit, Chalt, Sept. 1847, *J. E. Winterbottom* 971 ; Gilgit river valley, 1885, *Dr. Giles* 237—the grass is about the only member of the order that makes good a footing in this desolate region, growing in tufts up to 100 ft. above the river level ; ibidem, Doyan, 2200 m., 1885, *Dr. Giles*.

Chitral; Drosh, 1500 m., Apr. 1908, *Toppin* 177.

Waziristan; Torkhan, 1600–1900 m., Apr. 1893., *J. F. Duthie;* Barwand, 1300 m., 26 Apr. 1895, *J. F. Duthie* 15721.

Sind; *Dr. Stocks* 816 ; ibidem, Hilla, *Dr. Stocks* 690.

Afghanistan; *Griffiths* 365.

This typically desert plant is sometimes known as 'camel grass', apparently because it forms the principal grazing grass for camels in the desert. It contains an oil which can be obtained by steam distillation. According to Guenther, the odour of the oil recalls that of elemi oil, indicating that one of its constituents is phellandrene, a terpene useful for technical purposes, particularly as a solvent.

26. Cymbopogon parkeri *Stapf* in Kew Bull. **1929**, 10 (1929).

Andropogon laniger Duthie, Fodder Grasses N. W. Ind. t. 23 (1886)· non Desf.

A perennial grass, caespitose, compact, with many intravaginal innovation shoots, up to 1 m. tall, very woolly on the basal sheaths. *Culms* erect, slender, 3–4-noded, unbranched below the inflorescence, terete, glabrous. *Leaf-blades* plicate, narrowly linear, above filiform and long attenuate, up to 20 cm. long, 3 mm. broad when flattened, somewhat glaucous, with 3 prominent nerves on either side, with secondary nerves numerous and very close, covered on the lower surface with lax hairs some of which are long, scabrid on the nerves, scaberulous everywhere on the upper surface; *leaf-sheaths* of the basal leaves 5–10 cm. long, firm, pale, woolly towards the base, glabrescent above, persistent for a long time, at length apparently not twisted; those of the culms tight, greenish, glabrous and very smooth; *ligules* scarious, rotundate-truncate, 1·5 mm. long.

Inflorescence a spatheate panicle, narrow, interrupted, up to 40 cm. long, 6–7-noded, with the lower nodes 10–16 (rarely 20) cm. long, with the remainder rapidly decreasing in length upwards; spatheoles narrowly lanceolate, 3–4·5 cm. long, scarious, pale straw-coloured, sometimes reddish, without blades, glabrous; peduncles 1 cm. long, glabrous, filiform. *Racemes* 2, at length divaricate, with one at least epinastically deflexed, 1·5–2·5 cm. long, covered with white hairs; one sessile, the other supported on a slender basal internode 1·5 mm. long; the lowest joint of the sessile raceme with the adjacent pedicel swollen, hard, dark coloured; lowest fertile joints distended at the apex into a toothed cup, the remainder linear, slightly dilated above, truncate at the apex, with white hairs on the back and on the angle, up to 2 mm. long. *Lowest pair of spikelets* of the sessile raceme homogamous, of the other raceme heterogamous. *Fertile spikelets* linear-lanceolate, acuminate, 4–6 mm. long; callus very short, slightly bearded. *Lower glume* shape and size of the spikelet, chartaceous, more or less concave between the scabrid keels and especially deeply depressed towards the base and there slightly villous, 2-toothed at the top; *upper glume* boat-shaped, from the side narrowly linear-lanceolate, mucronulate, slender, 1-nerved, scaberulous on the keel, ciliate above on the hyaline margins, pilose on the back towards the base. *Lower floret* reduced to a hyaline lemma, nerveless, lanceolate-linear, ciliate, 3–5 mm. long, *palea* absent. *Upper floret* hermaphrodite; *lemma* narrow, 2–4·5 mm. long, cleft almost to the middle, hyaline, with ciliate lobes; *palea* absent; awn very slender, 9–13 mm. long, geniculate; *column* 3–6 mm. long, twisted; *bristle* smooth; *stamens* 3; *anthers* 2 mm. long. *Pedicelled spikelets* lanceolate-linear, 5·5–6·5 mm. long, glabrous, gaping broadly at anthesis, pale glaucous or slightly tinged with red; *glumes* scaberulous or ciliate-scabrid on the nerves; the lower 7–9-nerved between the keels; the upper slightly shorter, 3-nerved.

Lemma of the lower floret subulate involute, a little shorter than the glumes, almost nerveless, ciliate ; *stamens* 3 ; *anthers* 3 mm. long.

Ind. Or.: Uttar Pradesh, Etawah afforestation area, Aug. 1923, *R. S. Pearson* (Holotype) ; Punjab, Hissar, 28 Feb. 1886, *J. R. Drummond* 21097, 21098 and 21102 ; Ajmer, 17 Oct. 1887, *J. F. Duthie* 6760 ; Hissar Bir, Oct. 1897, *J. F. Duthie* 20705 ; Baluchistan, 8 May 1897, *Harsukh* 20666 ; Sind, India, without date or number, leg. *D. Hooper.*

A very distinct species, obviously revelling in dry, hot areas. It is, apparently, much commoner than realised, and is usually mistaken for *C. schoenanthus* Spreng. Indeed, the specimen and figure called by Duthie loc. cit., *A. laniger* Desf., is none other than this species. It is quoted by Stapf in the synonymy of *C. jwarancusa* in Kew Bull. 1906, (1906), with the remark ' a form approaching *A. schoenanthus.*' If this species contains an oil in its tissues nothing is known of it.

NATURAL HISTORY OF THE SOUTH INDIAN GERBILLE *TATERA INDICA CUVIERI* (WATERHOUSE)

BY

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Introduction

Among the many problems confronting the agriculturist is one which concerns the large-scale destruction of food crops by pests. While efforts are being made to assess the damage and suggest measures for biological control of a number of insect pests, nearly the same amount of attention has not been paid to the damage caused by the rodents, of which the gerbilles are of considerable importance. For instance, the Mysore Agricultural Calendar for 1949-50, dealing with Rodent crop pests, makes no mention of the common gerbilles, though in one of the earliest records, Blanford (1891) stated that 'these rats feed upon roots and grass, especially harayali (*Cynodon dactylon*), seeds and grain, and sometimes caused great damage to the crops. In 1878-79 they ravaged the grain fields in the Deccan throughout several thousand square miles cutting down jawari (*Holcus sorghum*) and bajri (*H. spicatus*) stalks and feeding on the grain, part of which they stored in their burrows'. Fletcher (1914) while recognising the damage caused by these gerbilles remarked 'normally it probably does some good because its favourite food is the roots of the harayali grass (*Cynodon dactylon*) which is a most pestilential weed as a rule . . . '.

Besides, our knowledge of the reproduction of a number of rodents, especially of the tropical species is very scanty. Drawing attention to this point Mossman and Judas (1949) remark 'In Rodents we have extensive information on a few species of the family Muridae, on one species of the Cavidae, on one of the Sciuridae and one of the Geomyidae and a little, mostly morphological, on a few members of the same families. This means that of the 32 living families of Rodents, we have a workable knowledge of only 5. Among the unknown 27, mammalogists have known for a long time that there are far greater diversities of reproductive pattern than among the other 5. How much are we justified in generalising about reproduction in Rodents?'

It was thought that a study of the reproductive phenomena of a member of the subfamily: Gerbillinae, family: Muridae, about which very little is known at present, would, besides filling the lacunae in our knowledge about this group of rodents, be of some economic value. The present study deals with the natural history of the Common South Indian Gerbille *Tatera indica cuvieri* (Waterhouse). The present report is based on extensive field observations and examination of trapped animals brought to the laboratory. A number of burrow systems were dug out completely and their occupants were captured by net. The data pertain to the area around Shivanahalli village, Bangalore District, Mysore State, South India, about three miles from the city limits of Bangalore. The collection extended over a period of over a year from August 1952 to December 1953. The observations recorded here may not be typical for this species in other parts of South India, as different regions exhibit marked differences in climatic conditions.

Environment

Bangalore lies in the middle of the Deccan plateau at a height of about 3,050 ft. above mean sea level. The city area is surrounded on all sides by cultivated fields which yield a variety of crops through the greater part of the year. The natural vegetation around Bangalore is of the dry deciduous category, where there are very few trees apart from those forming the avenues along the highways. This is on account of the scanty rainfall (average rainfall: 34.5 in. per year) and interference by man. Owing to the comparatively dry climatic conditions and the soil being exposed to the hot sun for the greater part of the year, the trees are stunted and seldom attain great dimensions. Before the monsoon the vegetation becomes active and green. *Cassia auriculata* is one of the most widespread and abundant shrubby species found in the open and as undergrowth in many of the slightly wooded areas. Dense impenetrable thickets of *Lantana camara var. aculeata* cover large tracts of land. The common shrubby species occurring in and around the fields are: *Acacia leucocephalia*, *Acacia arabica*, *Calotropis gigantea*, species of *Capparis*, *Anisomeles*, *Gymnosporia*, *Flacourtia*, *Streblus*, *Fluggea*, *Dodonea*, *Grewia*, *Canthium*, *Sopubia*, *Lepidogathis* and *Teucrinum*. The entire area is covered with a variety of grasses, namely: *Cynodon dactylon*, *Brachiaria distachya*, *Urochloa reptans*, *Setaria intermedia*, *Sporobolus sp.*, and *Eragrostis bifaria*, by the first week of August.

Of the crops supported mainly by the monsoon rains is Ragi (*Eleusine coracana*), the most important food crop of the area, which is grown under dry cultivation. Sowing is done by the middle of June or the beginning of July and the crops harvested in December. A mixed crop of legumes and cereals is grown with ragi to avoid a regular rotation of crops. A few of the more important mixed crops are: Jola: *Andropogon sorghum*, Red gram: *Cajanus indicus*, Avare: *Dolichos lablab*, Horse gram: *Dolichos biflorus*, Black gram: *Phaseolus mungo*, Bengal gram: *Cicer arietinum*, Cow peas: *Vigna catiang*, Sesame: *Sesamum indicum*, Castor: *Ricinus communis* and Ground nuts: *Arachis hypogea*, which are harvested completely by the middle of January. The fields are generally left bare for the rest of the period from February to June.

The climate of Bangalore does not present such marked contrasts in meteorological conditions as in other parts of South India. Records maintained by the meteorological department of the State for 40 years show that from January to March, clear skies, fine weather, low humidity, and slight diurnal range of temperature (80° to 83°) are the usual features. The north-east monsoon is slightly active during this period. The hot weather period of April and May is one of continuous increase in temperature to a maximum of 95° in the middle of May. Towards the first week of May the south-west monsoon bursts over the peninsula. The strength of the wind currents and the accompanying rainfall gradually increase from June and remain steady till the end of October. August, September and October experience heavy rainfall. The second half of the wet season forms a period of transition leading to the dry winter season, which begins by the first week of December and continues to the end of January. During winter the night temperature drops considerably (70°).

HABITAT

The gerbilles are mainly nocturnal and are confined to their burrows by day. The burrows are dug in soft soil on the borders of cultivated fields. They are occasionally found in deserted ant hills. Each burrow system has two or three openings and the passages are long, winding, 3 to 4 inches in diameter and extend to a depth of 4 to 5 ft. below the surface. Near the main entrance the tunnel branches off into two or three lanes all of which, except one, end in blind alleys and are thought to be meant for misleading stragglers into the burrows. The gerbilles constantly make new entrances leading to the different portions of the winding tunnels. These entrances are seldom used till the soil thrown out during the excavation is sufficiently dry. As the animal enters, after completion of the connection with the main tunnel, it partially seals off the entrance by kicking mud with its hind feet. These new entrances are the emergency exits. The fresh earth thrown out in working these exits generally gives away the position of the burrow system, which otherwise is carefully concealed in the undergrowth. When alarmed, the gerbille, with remarkable agility, unexpectedly darts out through one of the emergency exits to the open and dashes to a nearby bush to become instantly lost to view. In the centre of the main passage or tunnel an area is widened out forming the living and breeding chamber. The animal scoops out mud from the bottom of the chamber to form a shallow trough. Tender blades of grass from the neighbourhood (*Cynodon dactylon*, etc.), are finely shredded and arranged compactly in the trough on which the litter is laid or the animal rests. Normally each burrow is the home of an adult male and an adult female with their young.

A few burrow systems, undisturbed by human intervention, harbour a large collection of gerbilles numbering seventy-five or more. In such a large grouping of animals the correct identity of the extent and delimitation of the various burrow systems becomes difficult on account of their close proximity.

The gerbilles feed on the plant foods previously listed. The plants eaten are usually green, but some are hard seeds, small stems and rhizomes of a variety of grasses. A detailed analysis of the stomach contents is being published elsewhere.

SURVIVAL

There are a number of factors affecting the survival of individuals in a wild population of rodents. The survival of a considerably large number to the age of sexual maturity and their consequent breeding is of the utmost importance for the maintenance of the species. The physical environment does not seem to affect the survival of the gerbilles to a great extent as they were taken in sufficiently large numbers in all months of the year. During the rainy season (June to October) many of the low-lying burrow systems are flooded drowning a number of their occupants.

Frequently in winter, a number of animals are caught with their tails swollen and presenting a ringed appearance. A few had tails sore and broken. This is the 'ring tail' disease which also occurred in animals kept in the laboratory for breeding. This is probably due to the fact that at the beginning of winter, on account of the sudden drop in temperature, a few of the less resistant animals develop the disease. Otherwise, diseased animals are rarely noticed in a wild population of gerbilles.

Intra-specific struggle is very common. This is particularly marked in young gerbilles when they migrate from the parent burrow and establish new homes. A large number of young trapped during October and November, had wounds indicating that they had been involved in fights. Victims of a fight are commonly found bitten through the back of the neck. Young gerbilles are often eaten by the larger ones. Generally an opening is made at the back of the neck, and as the flesh and ribs are eaten the skin is pulled back. Skinning out through the thoracic rather than the lumbar region appears to be the more usual method of eating. Cannibalism has also been observed in animals kept in the laboratory.

Of the predators, the snake *Zamenis mucosus*, the mongoose *Herpestes* and the owls are important. In the fields near the village the domestic cat takes a heavy toll. The snakes swallow the gerbilles completely. Carcasses of gerbilles with a large portion of the body eaten away might be the remnants of predation by either the mongoose or the owl. Village folk consider the flesh of the gerbilles excellent eating and spare no pains to get them out of their hideouts. Any study of the 'Home ranges' and other trapping experiments fails on account of this interference by man.

BEHAVIOUR IN CAPTIVITY

The gerbilles are rather shy and timid and remain in their burrows for most part of the day. A number of specimens captured at different seasons of the year have been kept in wire cages for breeding. They were fed on the same grains as grown in the fields from which they were caught and were provided with fine straw as bedding. The grains were regularly alternated with a liberal supply of green leaves. During the day they lie curled up in a corner of the cage and the slightest disturbance startles them, when they move about agitatedly in the cage. All attempts made so far to get them to breed in captivity have failed. Perhaps the sudden change from a wild condition to the narrow confines of the cage, cuts short their activity besides taking them away from the warmth of the soil 4 to 5 ft. below the ground level. A number of pregnant females brought forth litters after a few days of their capture, but ate all the young within two or three days of their birth. This behaviour in captivity possibly indicates an extreme expression of the tendency towards cannibalism, characteristic of the species. Juvenile gerbilles are more easily managed and eat whatever is offered to them. They are more docile than the adults.

REPRODUCTION

No information is available concerning the reproduction and breeding seasons of the gerbilles except the observation of Phillips (1935) that in the Ceylonese gerbille 'The young are born at any time of the year but have generally been found during the north-east monsoon, October to April. The number of young is 4'.

Collection of material in all months of the year offered evidence of the fact that the young are born from September to the first week of March. The earliest litters are noticed in the burrows in the third week of September. Following this there is a continuous production of the young till the middle of February and a few stray births continue till the first week of March. From March to the end of August there were many gerbilles with inactive uteri. Histological examination of the ovary and uterus showed that non-parous animals were in a greater percentage than parous adults. The number of juvenile gerbilles weighing between 22 grams and 70 grams is on the increase from October onwards. Pregnancies were generally confined to the heavier weight groups (above 95 grams) pointing to the conclusion that the gerbilles do not breed in the same season as of their birth.

SIZE OF THE LITTER

The number of mammae is often a rough guide to the average size of the litter. There are four pairs of mammae in *Tatera indica cuvieri*; the first pair is pectoral; the second pair, thoracic; the third pair, abdominal and the fourth pair, inguinal in position. Thirty gravid females of the gerbille examined by me showed that the number of embryos ranged from 5 to 8. Usually a lactating female showed evidence of all the mammae having been used. The distribution of the embryos and the placental scars was almost equal between the two horns of the uterus. Litter counts collected from the burrows correspond roughly with the embryo counts in gravid females.

ACKNOWLEDGMENTS

My sincere thanks are due to Dr. B. R. Seshachar and Dr. H. W. Mossman for guidance and encouragement and to Dr. E. M. O. Laurie, British Museum of Natural History, London, for the identification of the gerbille. I am grateful to the Education Ministry, Government of India, for a liberal financial grant.

SYNOPSIS

The natural history of the South Indian gerbille *Tatera indica cuvieri* (Waterhouse), subfamily: Gerbillnae; family: Muridae, about which very little is known at present, has been described. The description pertains to the form occurring near a village about 3 miles from Bangalore, South India. The environment, vegetation and climate of the area are described. The gerbilles are nocturnal and live in burrows dug on the borders of cultivated fields. The burrows are long and winding passages with a number of emergency exits and a breeding or living chamber in the centre in which the litter is laid. The physical environment does not affect the survival of the gerbilles. Intra-specific struggle is in evidence at the time of migration of the young ones from the parent burrow to establish new homes. Cannibalism is of frequent occurrence. The snake, *Zamenis mucosus*, the mongoose, *Herpestes*, the owl and domestic cat are the probable predators. All attempts made so far to get them to breed in captivity have failed. Mothers have been observed eating their litter shortly after their birth in captivity. The young are born from the third week of September to the last week of February or the beginning of March. Gerbilles do not breed in the year of their birth. The litter size ranges from 5 to 8.

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NEW SPECIES OF INDIAN PLANTS

BY

R. Seshagiri Rao

Indian Botanic Garden, Calcutta

In previous numbers of this *Journal* and the *Journal of the Indian Botanical Society*, two plants were described, but the Latin diagnosis was not given; to comply with the prescriptions of Art. 44 of the new International Code of Botanical Nomenclature, the Latin description is herewith appended.

1. **Paragrewia poilanei** Gagnp. ex Seshagiri Rao. (*Journ., Bomb. Nat. Hist. Soc.*, 51 : 671, 1953).

Frutices. Rami tenues, glabri, 2-3 mm. diam. *Folia* alterna, stipulata (stipulis deciduis), petiolata, oblanceolata vel fere elliptica, integra, acuminata, membranacea, glabra in utraque pagina reticulata; lamina 11-17 × 2.5-4 cm.; petiolus glabrescens 6-10 mm. longus foliorum basis fere obtusa vel tenuiter acuta. *Inflorescentia* axillaris cymosa, pauciflora. *Flores* brevi-pedicellati, bracteati, actinomorphici, hermaphroditi, hypogyni. *Sepala* 5, 6-8 mm. longa, libera, valvata, puberula in superiore pagina. *Petala* 5, minuta, libera, 1-1.5 mm. longa, imbricata, pubescentia ubique, pilis marginalibus eminentibus, depressione glandulari ad basim in interiore parte nulla. *Stamina* 10-15, unita ad basim circa ovarium, nonnulla contracta in staminodia minuta, conica, nonnullis pilis ad apicem ornata; filamenta tenuia, puberula; antherae 2-cellulares, oblongae, introrsae, basifixae, dehiscentes per longitudinalem fissuram. *Gynoecium* thalamo glandulari infixum, androgynophoro nullo; stylus aeque longus ac stamina, partim pilosus; stigma acutum, 3-4-fidum; ovarium pilosum, 3-4-cellulatum, ovulis plurimis insitis placentis axillaribus. *Fructus* haud visus.

Shrub; *Branches*: slender, glabrous, 2-3 mm. in diameter. *Leaf*: alternate, stipulate, (stipules deciduous), petiolate, petiole glabrascent, 6-10 mm. long, lamina 11-17 cm. long ,2.5-4 cm. broad, leaf base nearly obtuse or slightly pointed, oblanceolate or nearly elliptic, entire, acuminate, membranous, glabrous on both sides, 3-nerved at base, 5-8 pairs of secondary nerves, pinnately reticulate. *Inflorescence*: axillary, cymose, few-flowered. *Flower*: short-pedicelled, bracteate, actinomorphic, hermaphrodite, hypogynous. Sepals: 5, 6-8 mm. long, free, valvate, finely pubescent on upper surface. Petals: 5, minute, free 1-1.5 mm. long, imbricate, hairy all over, marginal hairs prominent, glandular depression at the inner base absent. *Stamens*: 10-15 united at the base around the ovary, a few reduced to small conical staminodes with a few hairs at the tip, filaments slender, slightly hairy, anthers dithecous, oblong introrse, basifixed, dehisce by longitudinal slits. *Gynoecium*: on glandular thalamus, androgynophore absent, style as long as stamens, partly hairy, stigma pointed, 3-4 branched, ovary pilose, 3-4 celled, ovules numerous on axile placentae. *Fruit*: not available.

2. **Chonemorpha pedicellata** Seshagiri Rao, spec. nov. (*Journ. Ind. Bot. Soc.*, Vol. 32, No. 1, p. 44, 1953).

Folia petiolata, elliptica, 22-27 × 11.5-14.5 cm., acuta, integra, angusta ad basim, glabra supra, puberula infra, nervo medio canaliculato atque piloso supra, nervis primariis 10-11 in utroque latere nervi medii, prope margines curvatis; petiolus puberulus, 2-2.5 cm. longus. *Inflorescentia* longe pedunculata, ad primum puberula, 14-20 cm. longa, cymosa, multiflora, bracteis suaviter tomentosis, lanceolatis, 9-11 mm. longis. *Flores* longissime pedicellatis, pedicellis pulchre pubescentibus atque 3.8-5 cm. longis. *Sepala* 5, unita, puberula, 12-15 × 4-5 mm., segmentis angustis, conicis, circa ⅓ aeque longis ac calyces. *Petala* 5, unita, hypocrateriformia; corollae tubus plus minusve cylindricus, abrupte fastigatus ad basim; petala 4.5-5 cm. longa, segmentis vel lobis ad sinistram versis, oblique obovatis, tenuiter multinervis, circa 3.5 cm. longis, 1.5 cm. latis.

Leaves: petiolate, elliptic, 22-27 cm. long, 11.5-14.5 cm. broad, acute, entire, base narrow, glabrous above, finely pubescent below, midrib chanelled and hairy above, primary veins 10-11 pairs, gently forming loops near the margin, petioles finely pubescent, 2-2.5 cm. long. *Inflorescence*: on long peduncle, finely pubescent when young, 14-20 cm. long, cymose, many flowered, bracts softly tomentose, lanceolate, 9-11 mm. long. *Flowers*: on very long pedicels which are finely pubescent and 3.8-5 cm. long. *Sepals*: 5, united, finely pubescent, 12-15 mm. long, 4-5 mm. broad, lobes narrow, conical, about ⅓ the length of calyx. *Petals*: 5, united, hypocrateriform, corolla tube more or less cylindrical, abruptly tapering downwards near the base, 4.5-5 cm. long, lobes twisted to left, obliquely obovate, finely multinerved, about 3.5 cm. long and 1.5 cm. broad.

My grateful thanks are due to Rev. Fr. H. Santapau, S.J., for Latin translation.

REVIEWS

1. ANIMAL WONDERLAND—ESSAYS IN NATURAL HISTORY. By Frank W. Lane, pp. 232, London, Country Life Ltd., 2-10 Tavistock Street, Covent Garden, W.C.2. 1948. Price *7s. 6d.*

Not caring for disconnected tales of wonder relating to animals I approached this book with considerable distaste. For those who are interested in such things the first few chapters contain much curious and interesting information. The story of a crow who managed to knot her tail round a tree cannot fail to bring a smile to the face of the most stolid. Equally funny is the tale of the snake which bit a motor tyre and was inflated to bursting by the inrush of compressed air through its hollow fangs. And one cannot but admire the cleverness of the honey merchant who employed bees to smuggle his stock-in-trade across the Italo-Swiss frontier. It was in this portion of the book that I found a solace for wounded vanity. Years ago I missed an easy shot at an otter with a 12-bore gun. It is consoling to learn from Mr. Lane that an otter moves fast enough to dodge even a rifle bullet. Mr. Lane's engaging style tells to advantage in the later portion of the book, which takes the form of articles dealing with particular aspects of animal life and behaviour. There is a fascinating account of 'bird—anting' in which the author has attempted to collect all the information on the subject. This is followed by an equally interesting discussion of the hedge-hog and apples legend. In another article the author tells the readers about the passenger pigeon and the American bison. It is difficult for the human mind to comprehend the astronomical figures in which the numbers of these creatures are generally stated. The descriptions of eye witnesses cited by the author makes it possible, and at the same time gives an idea of the widespread destruction caused by them. In the roosting places of the passenger pigeon, which might be one hundred square miles or more in extent, the dung lay several inches deep and all tender grass and underwood was destroyed; the ground was covered with branches of trees broken off by the weight of the roosting pigeons, and the trees themselves were killed as if completely girdled. Such destruction we are told might continue for years and could be seen in several places. It is usual to speak in pathetic terms of the manner in which man has exterminated these two species, and it is as well, therefore, to be told of the other side of the picture.

The book is well got up and reasonably priced and can be recommended for general readers.

D.E.R.

2. LEOPARD OF THE HILLS. By James Temple with illustrations by Maurice Wilson, pp. 190, G. Bell & Sons, Ltd., London, 1953. Price *12s. 6d.*

This life story of a leopard will appeal to all who love the Indian jungle and its folk. The trials and tribulations of cubhood, the slow and at times painful acquisition of knowledge and of the all-important lesson how to see without being seen, the different ways in which felines may receive injuries which hinder their hunting, and finally how 'Chitwa' doubly lamed by bullet and trap, is driven by hunger to become a man-killer with the inevitable sequel, are all vividly and realistically depicted. The author has done well to avoid endowing his character with human speech, the bane of so many animal stories; he is content to give him simply the intelligence and cunning gained by experience which any leopard may reasonably possess. The whole story rings true and the sole exception to our own experience is the account of a pack of pine-martens running down and killing a doe barking-deer. That martens will at times kill a fawn is well known, but would they even in combination attack a full-grown animal? However, the author obviously has much experience of the jungle, and may have personal knowledge of such an incident, so it is well to bear in mind Conrad's dictum that 'nothing lays itself open to the charge of exaggeration more than the language of naked truth'. The reason given for tigers liking water while leopards avoid it so far as possible, is new to us, but is undoubtedly correct. The author is to be congratulated on producing such a very readable book which should be in the library of everyone interested in Indian Wild Life.

P.A.G.E.

3. THE BIRDS OF BURMA. By B. E. Smythies, B.A., with 31 colour plates by Commander A. M. Hughes, O.B.E., R.N., (Retd.). Pp. 668, (Oliver and Boyd) London, 1953. £4-4-0.

The appearance of a new edition of *The Birds of Burma* will be a matter of interest to all.

The first edition was published in 1941 and at once attracted attention by the 31 coloured plates by Commander A. M. Hughes illustrating 290 species of birds, which provided what the ordinary person had been demanding for years. The usefulness of such a large number of coloured plates was enhanced by their intrinsic beauty and neatness of line. The book then appeared under the name of B. E. Smythies, I.F.S., and edited by H. C. Smith, I.F.S., and P. F. Garthwaite. Smythies explains in the first edition that these gentlemen had done a great deal of the preliminary work and that J. K. Stanford, I.C.S., was to have written the text. The first edition of 1,000 copies was printed at the American Baptist Mission Press at Rangoon and a very good job they made of it. In the preface to the second edition Smythies tells us of the fate of the first edition. Most copies were sold in Burma and were left behind by their owners when the Japanese overran the country. Most were collected by the Japanese and sent back to Tokyo but were then burnt in an Air Raid. Only a few copies were sold outside Burma and the second-hand value rose to £25. The precious paintings were carried out by Mrs. Smith in her 30 pounds evacuation allowance and spent the rest of the war in a safe deposit in Bombay: 21 out of the 31 blocks from which the plates were printed were found by Smythies and carried to safety by the Royal Navy, and spent the war in Khatmandu. After the war the Baptist Mission Press did not re-open and the new edition has been brought out by Oliver and Boyd. Those who owned the first edition will want to know how the new edition compares with the old and in particular the unique and beautiful plates.

Despite the very creditable work of the Baptist Press it must be conceded that the plates in the new edition are better: the outlines are much sharper without any blurring and the new plates bring out the gradations in shades much better. For example plate VIII showing the Drongos shews much more subtlety in the variations in shade.

In the third edition we can ask the author to supply a list of the plates at the beginning of the book. This is a curious omission.

The text has been re-written throughout by B. E. Smythies for the new edition and the completion of such a task fills one with admiration and astonishment, that a working Forest Officer could find the time for this. Mr. Smythies is rather pessimistic over the further study of birds in Burma as with the departure of all foreigners there are none left to carry on the work and so far no Burman has shewn any interest. However I am sure this beautiful book will spur on the young men and women of Burma to start now.

For those who do not know the first edition some details of the book are necessary. The text is an attempt to put down everything that was known about the birds of Burma upto 1948. It is no reflection on the book to say that what is recorded indicates more clearly than anything else how much is yet to be learnt. A good deal of new information has been added in the new edition.

The arrangement is that the more important birds are printed in larger type and the less frequent and less widely distributed in smaller type. This is adopted to save space. As it is the book is of 668 pages so the need for this can be fully appreciated. The author claims there are probably 1,000 species in round numbers in the avifauna of Burma of which 953 are already recorded.

For each important bird the headings are:—

Local name.
Identification.
Voice.
Habit and food.
Nest and eggs.
Status and distribution.

The identification depends on the coloured plates but notes on variation between the sexes, and other details are given.

Under voice an attempt is made to describe the calls and song.

Under habit and food in the first edition the author (with due acknowledgment) made considerable use of Whistler's Popular Hand-Book of Indian Birds. Whistler is inimitable in his descriptive sections and the pen pictures he paints alone have made his book worth buying to the lover of good English. In the second edition, Smythies has cut down these extracts and left the bare bones. This was probably inevitable if the book was to be kept to one volume.

Under nest and eggs the information available about each species is given but there is obviously a big field for further observation. The times of nesting, etc., vary enormously in a country which stretches from 10 deg. to 26 deg. north and varies in altitude from sea-level to 19,000 ft.

Under status and distribution is noted whatever is known about the migration and movement of the bird and its range both inside and outside Burma.

It is thus essentially a repository of what is known and keeps strictly to business and there are few rhapsodic passages on the beauty of the individual birds. Along with this, notes are given on races, etc. and these include the latest information provided by American and Indian investigators.

One other change on which I am not competent to comment is the change in nomenclature. The author tells us that he has adopted the findings of American authorities and this appears to have one advantage for the weaker members in that a lot of 'lumping' has been done in the generic names and so the number of genera is reduced. I see however that Sálim Ali sticks to the old names in his *Birds of Travancore and Cochin* which is published in November, 1953 and if such an eminent authority has not followed the Americans, I am sure we will not get rid of the extra names so easily.

Finally I strongly advise people to order the book, look at the Jungle Cock on the dust cover, open the book in the middle and feast on the beautiful plates and promptly pay the bill without letting that first glow of excitement fade. They can later find the money by giving up smoking for a year. Their health will not suffer and they will be in possession of one of the finest Bird Books published anywhere in the world.

C.E.H.

4. HOOFED MAMMALS OF THE WORLD. By Ugo Mochi and T. Donald Carter. Pp. 94 (12″ × 15¼″) with 40 plates (silhouettes) Charles Scribner's Sons, New York, 1953. $15 nett.

This is an attractively got-up work on the hoofed mammals of the world and covers the entire diversity of forms such as the Giraffe, Okapi, the many Deer and Antelopes, Wild Goats and Sheep, Chevrotains, Buffaloes, Bison, Yak, Wild Pigs, Hippopotamuses, Rhinoceroses, Tapirs, Wild Horses, Asses and Zebras.

Of the 940 recognised forms of modern ungulates, most races and subspecies are referred to and only those which are almost identical in form and structure are not illustrated. The geographical distribution of each species and the characters of the various geographical races or subspecies are described and often discussed in detail.

The book carries a great deal of information on habits and habitats of the various species, and in several instances these notes are based on first-hand observation and experience. The value of many species as 'game animals' is discussed and the need for protecting the rarer forms is suitably stressed. There is also much valuable information on the domestication of the various species and their economic importance.

Donald Carter's extensive field experience and keen powers of observation have contributed largely to the wealth of information gathered in this book. A fair idea of the thoroughness with which the animals are dealt with in this book may be had from the fact that, no less than twelve different geographical races of the Giraffe are comparatively described and illustrated, and about twenty-nine distinct forms are described under the heading 'Miscellaneous European and Asiatic Deer', giving precise information on their diagnostic characters and geographical ranges. The brief sketch of the history of Pere David's deer is of particular interest as this species has now been unknown in the wild state for many years.

Up-to-date information on several interesting points such as the growth and shedding of the antlers in deer, the relative speeds of the more fleet-footed forms, breeding habits and parental care, together with vivid accounts of sport and adventure often based on first-hand observation by the author, render the book highly interesting to the layman and greatly enhance its value.

The book is illustrated by forty full-page plates of silhouettes which have been executed with great skill and accuracy. Ugo Mochi has used this unusual technique to the best advantage. Each illustration is carefully cut out of a single piece of paper with a knife. His illustrations, instead of being mere outlines, are seen in relation to space, and give the impression of life and movement. His principle is based on the assumption that true form is the main character distinguishing an animal, colour and shade being secondary. This technique of illustrating animals by silhouettes deserves praise as a bold and unique venture which is at once simple and effective.

The binding, format and typography of the book leave nothing to be desired, and it is one of the exceptionally beautiful Natural History publications which should find a place on the shelves of every Nature-lover.

S. THOMAS SATYAMURTI

5. THE PHARMACOGNOSY OF AYURVEDIC DRUGS. Series I, No. 2. Published by the Central Research Institute, University of Travancore, Trivandrum. 1953. 24.5 × 18 cms.; pp. vi + 104; plates 9 in colour, 22 half-tone. Price ?

The first number of this interesting series was reviewed in this *Journal* (50: 920-921, 1952); the present number has not only kept up the standard of its predecessor, but in a way has improved upon it. The printing is clear and neat, the plates good and well printed. The treatment of the subject is similar to that of the first number. Plates showing external characters of plants all give a scale in inches; on the other hand plates showing details of internal anatomy do not do so; even such plates should bear an indication of the scale in mm. or microns, and this can be given on the plate itself, or in the text that accompanies the plate.

Before a plant is discussed from the botanical or medicinal point of view, references are given to Ayurvedic literature. Some readers seem to have remarked that such references should be given in Devanagiri script, in place of the rather complicated roman type with numerous diacritical marks. In the opinion of this reviewer, perhaps it would be better to omit such references; it would suffice to give a summary of the traditional medicinal uses of the plant, without quoting the original texts at all. Such texts may be of great interest to Sanskrit scholars, but are of relatively little interest to the botanical or medical reader.

On p. 1 *Chonemorpha macrophylla* G. Don is discussed; it might be worth mentioning that the correct name of the plant is only *Ch. fragrans* (Moon) Alston. Similarly on page 49 *Stereospermum tetragonum* DC. is mentioned together with *S. suaveolens* DC. Chatterjee in the *Bull. Bot. Soc.*, Bengal 2: 62-79, 1948, has reviewed the Bignoniaceae of India and Burma and shown that our common Indian plant should be called *Stereospermum personatum* Chatt. In the spelling of scientific names we have noted a few mistakes, but this is of little consequence, except that in a work of such standard even minute errors are to be deprecated.

Without hesitation the book can be recommended to all those interested in the study of our medicinal plants. The complete series promises to be a monumental work of which India can be justly proud.

H. SANTAPAU, S.J.

6. THE INDIAN PHARMACEUTICAL CODEX. Volume I—Indigenous Drugs Approved by the Pharmaceuticals and Drugs Research Committee. By Dr. B. Mukerji, Director, Central Drug Research Institute, Lucknow. Council of Scientific and Industrial Research, New Delhi, 1953. 25.5 × 17 cm.; pp. x + 431.

This is an excellent book on the subject of Indian Drugs. After a short Preface and Introduction, the book consists of two parts: 1. General Monographs. 2. Formulary. There follow two short appendices, and two indices, the first of scientific names, the second of common vernacular names.

In the first part, the following is the treatment of each item: Name of the medicine or plant; synonyms of the same; vernacular names; specification of the drug; distribution; description of the source plant; characters of the part that is medicinally used; constituents of the drug; action and uses; standards and tests; substitutes and adulterants; storage; dose; preparations.

The second part of the book consists of a formulary, where subjects are treated thus: Name of the specific medicine; synonyms; method of preparation of the drug; standard; assay; storage; dose.

The book is the result of many years of study by one of our most distinguished scholars, Dr. Mukerji; when the Government of India opened the national laboratory for the study of Indian drugs at Lucknow a few years ago, Dr. Mukerji was selected as its first director, a post that he has been filling with distinction up to the present.

The standard of the work is fully in keeping with the name and position of the distinguished author.

'This book gives, for the first time, correct standards, methods of preparation, dosage and other details pertaining to indigenous drugs' (Preface by Dr. R. N. Chopra, p. viii). 'The present work will be welcomed by all those who are interested in drug therapy and who believe that many of the indigenous drugs can be substituted with advantage for foreign imported drugs. Medical practitioners do not prescribe indigenous drugs, as no standards have been laid down for many of them.' (Ibid. p. vi).

The presentation of the work, the printing and even the binding make this an attractive volume. The Council of Scientific and Industrial Research of India will have rendered a good service to the country if by means of this book medical practitioners are persuaded to take up some of the more effective indigenous drugs in their treatment of disease. With the incomparable wealth of medicinal plants we possess in India, it is a pity that we should go to foreign countries for this essential commodity. Careful use of the book will show that it is possible to use our national assets to the best advantage in the treatment of disease.

H. SANTAPAU, S.J.

7. THE BIRDS OF THE BRITISH ISLES. By David A. Bannerman and George E. Lodge, Volumes, I and II. Passeres. Oliver and Boyd, Edinburgh and London. 45*s* nett.

There are so many books on British birds that Dr. Bannerman is fully justified in saying that 'there was not much room for' another, unless it could be planned on original lines. It is not, perhaps, very easy to discover what Dr. Bannerman's 'original lines' are, but he has certainly made the text of the work both authoritative and readable.

The main feature of the work is, undoubtedly, the fact that every species is illustrated by that most gifted artist, George Lodge. Opinions differ about the quality of Lodge's work, but the present reviewer can testify that when he first saw Lodge's black and white text figures in Hudson's 'British Birds' over fifty years ago, he suddenly got a new idea of what bird drawings could be. Here were live birds, running about in the fields or perched as any small boy could see them perched any day in tree or shrub. They were not mere museum specimens. He has never altered his opinion, so he whole-heartedly welcomes this latest (and alas ! last) book full of the beauty and charm of Lodge's pencil and brush. They are worthy of the master-artist.

Lodge, the octogenarian, has died since these two volumes were published. Bannerman says that the artist contributed some 384 original paintings and £5,000 towards the cost of production. It is not quite clear whether further volumes are intended—even to complete the Passeres at least one more is needed; but if the paintings are available it is to be hoped that the project can be financed, so that the complete Lodge-cum-Bannerman British bird-book will be available to the public.

H.G.A.

8. THE BIRDS OF WEST AND EQUATORIAL AFRICA, 2 volumes. By David A. Bannerman. Oliver and Boyd, Edinburgh and London, 1953. £6 6*s*, pp. xiii + 1,526.

Dr. Bannerman is the author of the standard work on West African birds. This work appeared in eight volumes; the first was published in 1925, the last in 1951. So much new knowledge had come to light in the course of over twenty years that the final volume is in fact a supplement, an attempt to bring the earlier volumes up-to-date.

The present work is an up-to-date condensation into two bulky volumes of what was formerly only available in the much larger and very heavy eight volumes of the earlier work. Sir Alan Burns justly remarks in his preface that the 'small Bannerman' will quickly win for itself as many friends as the 'large Bannerman', and it will, no doubt, be the preference for all who are not systematists or men of wealth. Many of the excellent features of the earlier work are preserved, including thirty-seven coloured plates, and convenient identification keys.

The volumes contain no map; and it is not easy to determine just what area is fully covered; primarily, this, like the earlier work, is on the birds of West Africa, so that the title is slightly misleading. In the preface Dr. Bannerman observes: 'It has been found by analysis that of the 1,536 species and subspecies which inhabit West Africa, quite 75% range right across the continent and if it is not exactly the same race which occurs in the Belgian Congo, Kenya Colony, Uganda and the Egyptian Sudan, then those countries have their geographical representative which will be found in the text.' But there must be a quite number of species inhabiting the countries named which do not occur in West Africa. These are presumably not included.

H.G.A.

ADDITIONS TO THE SOCIETY'S LIBRARY

The following books received for review have been added to the Society's Library since November, 1953:—

1. SEARCH FOR THE SPINY BABBLER—Bird hunting in Nepal. By S. Dillon Ripley (Victor Gollancz Ltd., 1953).
2. THE BIRDS OF WEST AND EQUATORIAL AFRICA—Volumes I and II. By D. A. Bannerman (Oliver and Boyd, 1953).
3. THE BIRDS OF BRITISH ISLES—Volumes I and II. By D. A. Bannerman and G. E. Lodge (Oliver and Boyd, 1953).

4. A COLOURED ATLAS OF SOME VERTEBRATES FROM CEYLON—Tetrapod Reptilia. By P. E. P. Deraniyagala (The Ceylon Government Press).

5. THE SNAKES OF INDIA AND PAKISTAN—Fourth edition. By Lt.-Col. K. G. Gharpurey (The Popular Book Depot, 1954).

6. THE PALAEOBOTANIST—Volume II. (Birbal Sahni Institute of Palaeobotany, 1953).

7. THE BIRDS OF BURMA—Second edition. By B. E. Smythies (Oliver and Boyd, 1953).

8. LEOPARD OF THE HILLS. By James Temple. (G. Bell & Sons Ltd., 1953).

9. JUNGLE LORE. By Jim Corbett (Oxford University Press, 1953).

The following books have been presented to the Society's Library:—

1. MAN IN THE MAKING—Studies in Philosophy No. 3—University of Mysore. By J. B. Freeman (The University of Mysore, 1950) (By J. B. Freeman).

2. MOUNTAIN BIRDS. By R. A. H. Coombes (Penguin Books, 1952) (By H. G. Alexander).

3. THE CENTRAL BOARD OF GEOPHYSICS—A Compilation of papers on the Assam Earthquake of August 15, 1950. By M. B. Ramachandra Rao (The Central Board of Geophysics, 1953) (By The Secretary, Central Board of Geophysics).

MISCELLANEOUS NOTES

1. MAN-EATING TIGER IN SOUTH INDIA

In view of the paucity of records of man-eating tigers in South India, it may be worth recording that this month a tigress with cubs killed, dragged off, and devoured a Sholaga at Gundimalam, Kollegal Taluk, Coimbatore District. I just missed bagging the man-eater by a stroke of ill-luck one evening; and she and her cubs cannot now be located. Only one member of the victim's family remains; four others also met with death in the jungle; two fell from trees and were killed; one was mauled by a panther and died; and another was fatally gored by a bison. Only after we had located and collected the man's remains (and his bill-hook and clothes) would the sholagas of Gundimalam accompany me in my search for the tigress. Until the remains were found and gathered it would be, they said, courting disaster to go after a man-eater.

Honnametti Estate,
Attikan P.O.,
via Mysore (S. India),
October 29, 1953.

R. C. MORRIS

2. PANTHER KILLED BY DOMESTIC BUFFALOES

I have often heard of domestic buffaloes and cattle defending themselves against and sometimes attacking felines though I have not previously come across a case of a kill.

Recently here, a herd of buffaloes had just been driven into a stone kraal for the night when a fairly small though full-grown male panther jumped for an instant onto the bank and, the poles not being fixed, stampeded the herd.

The panther then retired to a position on an open grassy slope below the kraal where in the haste of the moment he apparently let himself be surrounded by the herd and was immediately attacked by a big herd bull.

On the second day he was brought in and had evidently died as a result of the encounter the same night. There was a deep gore under the left shoulder and another in the neck.

I understand that two buffaloes were killed out of the same herd the previous week but I am unable to say whether this was the work of a tiger or panther as unfortunately they were not reported at the time. Evidently the herd was ready to deal with their aggressor on this occasion.

Curzon Estate,
Kotagiri P.O.,
Nilgiris (S. India),
January 2, 1954.

J. M. POWER

3. MORE NOTES ON THE INDIAN BUFFALO

Bubalus bubalis, the Indian wild buffalo, is one of the rarest animals in the subcontinent, and one of the most interesting. These notes made over a period of five years (1949-1953) in Bastar District of Madhya Pradesh are intended as a supplement to Mr. Prater's chapter on the wild buffalo in 'The Book of Indian Animals' and must not be construed as an independent or self-contained work.

1. The origin of the solitary bull: There is no season of the year when the mature males leave the herd and congregate together, as is the case with certain other animals, notably black buck. Nevertheless it is an undisputed fact that solitary males are often found and that these males are the biggest. They are not solitary from choice, because I have myself seen them attacked and driven off when they try to rejoin the herd. It appears that the stud bull becomes overbearing and intolerant of other males at a certain stage of his life. When this happens, the other bulls in the herd form an alliance and turn on the dictator, who is either killed or driven out of the herd. Such solitary bulls frequently attach themselves to tame herds which enter their jungles to graze, after killing the tame stud bull, or, more frequently, they mate with the tame cows whenever an opportunity occurs, without actually joining the herd. The offspring are remarkably like wild buffalo, but the number which die at, or soon after birth, is large. This appears to be due to the larger size of the calf, which causes complications in delivery. The percentage of survival increases in the second generation, as might be expected. I have seen the buffaloes of a certain village Nilji, which are almost three-quarter wild buffalo, and the owners now encourage wild bulls to mate with their cows. But this is exceptional; in most cases owners do not like wild crosses, due to the high death-rate at delivery, not only of the calf, but of the mother as well.

2. The chela bull: After watching wild buffalo closely for more than five years, I have come to the conclusion that the solitary bull is seldom really alone, particularly if he is a big one. I first heard the story of the chela from a Muria friend, and I did not believe it, until I had personally investigated four cases. It is easy to miss the chela, unless you are looking for him. He is extremely self-effacing, and acts as a sentry and general attendant for the bigger bull. Very careful stalking is necessary if the two bulls are to be seen together, and I would not recommend the pastime to novices in the art, as the chela is likely to charge without provocation, while the bigger bull escapes. I cannot explain the existence of the chela, unless it is because buffalo are naturally gregarious, and like the company of their own kind. But why another bull? And why does not the original solitary animal try to build up a herd of his own? The chela is by no means an immature youngster; in fact, he also has been outlawed from a herd, just like the guru bull. The two will only be found together when resting, or when on the way to pasturage. Then they split up, and spend the grazing hours in different places, to meet again at the lying-up site. I have known the chela to rejoin the guru when the latter was wounded; I have

also known the chela to visit the guru's pasturage as soon as the guru was dead. A chela who is guarding a wounded guru-bull is extremely dangerous and is more likely to ambush the trackers than the wounded bull himself. Fortunately such instances of devotion are not common; I have come across only one.

3. The temperament of the solitary bull: The bull buffalo has an undeserved reputation for cause-less ferocity. I have watched him at different distances for long periods at a time, I have photographed him at close range, and I have even abused him (quite unjustifiably) from a car to which he refused the right of way. The only times I have actually been charged were when he was wounded, when he had just been driven out of the herd, and when the man with me lost his nerve and bolted. I am emphatically of the view that a buffalo is not aggressive unless he is wounded, or unless his fear is aroused by any sudden movement. He will shake his head from side to side, and even paw the ground, but these are only 'show off' demonstrations, and need not be taken seriously. But if he moves towards you, even slowly, get up or behind the nearest tree; he means business; the buffalo knows only one kind of advance, the kind from which there is no retreat.

A solitary bull that acquires the habit of eating crops, is a curse to the cultivator. A charge of coarse salt fired from a muzzleloader into his rump at short range will often discourage him, if anyone can, and will, get close enough for the purpose. I did it twice, at night. The first time it was alright, the buffalo ran away. The second time, something went wrong, and it was I who ran away—at world record speed! There was no third time. The salt does no damage, and is, I think, preferable to killing or wounding an already rare animal. But nothing else will drive him away from the succulent paddy or urid, no amount of noise, or showing of lights. The damage one buffalo can do to a field, has to be seen to be believed.

4. The wounded buffalo: In his own jungles, the buffalo is frequently in fairly dense cover, with the result that only about six inches below the top of his shoulder is visible. A bullet placed there will seldom kill in the same day. The bullet must always be a solid type, of at least 300 grains. If a vital spot is not visible, do not shoot. I dislike the shooting of buffalo, and I am only referring to it because I dislike the wounding of them even more.

A wounded buffalo will invariably try to ambush his trackers. He lies on his stomach, front legs bent and hind legs under tension, facing back along his tracks. If wounded on the right, he will usually circle to his left; if wounded on his left, he will circle to his right. In either case, the method of laying the ambush is the same—he will return about fifty yards along his tracks and lie up beside them, ten or fifteen yards away from the line of tracks. The place selected is fairly open; I have never known an ambush in really dense jungle. Unless one is alert for an ambush, and sometimes even then, the first indication of the buffalo is when he is almost on you. After which it is all a matter of shooting, and luck—mostly the latter. Nothing but instantaneous death will stop a charging buffalo. A good shot has a fifty per cent chance of survival.

If not finished off before the maggots form in the wound, the buffalo will lie all day in water deep enough to cover his wound, and only leave it to graze at night, if he is capable of grazing. His vitality is enormous, and he will cling unbelievably to a thread of life. I repeat, do not shoot buffalo; but if you do, kill cleanly and mercifully. I have had to follow far too many of other men's woundings.

5. Pasturage: A buffalo is a selective feeder, in spite of his size. He will browse through what seems to be tender grass, picking a mouthful here and a mouthful there, covering long distances in the course of his grazing. A careful examination will show that, in an apparently casual fashion, he has managed to select only the choicest bits. His grazing is done in the night and early morning or late evening, the day being spent in dense cover. It is probable that this change from the habits described by Sir Samuel Baker in the early 1890's is due to the increased disturbances to which he is subjected now-a-days. His habitat too has changed; he no longer lives in the open grassy places, and tends to frequent denser forests. A sure spot to find him in, during the latter months of the hot season, is an open maidan in the forest after it has been burnt, when the young grass begins to sprout. Five in the evening is the best time, if you want a photograph.

JAGDALPUR P.O.,
BASTAR DIST.,
MADHYA PRADESH,
December, 1953.

R. P. NORONHA

4. GAUR ATTACKING MAN

A Sholaga was recently killed by a gaur bull, which made an unprovoked attack on him in long grass. Nearby the remains of a cow, or young bull, which had been killed by a tiger, were found.

This appears to be yet another instance of a bull bison charging, apparently unprovoked; a tiger being in the vicinity.

In a previous note to the *Journal* I referred to three instances of unwounded bulls charging and in every case a tiger was found to be in the same area at the time. In the *Journal*, Vol. 50, No. 1, Mr. A. F. Hutton describes a case of a plantation labourer being attacked and killed by an unwounded gaur bull; here again a tiger had been around, and had badly mauled another bull nearby. It would seem as if the protracted presence of tiger has a maddening effect on bull bison; even if they are not actually mauled.

Not long ago I came on a dead bull (it had died only a few hours previously), which had obviously succumbed to blood-poisoning following an attack by a tiger. It was obvious from the broken saplings and smashed bushes in the nearby shola that the poor creature had been in a bad temper only the day before; had I come on it unawares a day earlier I might have been in for trouble.

Honnametti Estate,
Attikan P.O.,
via Mysore (S. India),
December 8, 1953.

R. C. MORRIS

5. THAMIN OR ELD'S DEER [*PANOLIA ELDI THAMIN* (THOMAS)] IN BURMA

There are two Wild Life Sanctuaries primarily constituted to perpetuate Thamin, the typical deer of Burma. The Shwezettaw Wild Life Sanctuary was constituted in 1940. It is situated in the Minbu Forest Division. The approximate area is 213.4 sq. miles. When proposals were submitted in 1937, there were at least 100 Thamin in the area. They were on the increase in 1946-47 and 1947-48. Over 300 Thamin were then reported in the Sanctuary. But since 1948-49, the area has been under occupation by underground Communist insurgents. The Divisional Forest Officer, Minbu, informed me in September 1953 that 'the number is on the decrease and that poaching is still going on during these days of insurrection'.

Kyatthin Wild Life Sanctuary was constituted in 1941. It is situated in the Shwebo Forest Divison. The approximate area is 104 sq. miles. Touring is not possible as yet. The Range Officer, Kyatthin, who has been in charge of the range for the past several years estimated the number of thamin in the sanctuary as 150.

Outside the sanctuary thamin still exist in the unclassed forests east of the railway line in the Kanbalu Range, Shurbo Forest Division. According to the Annual Report on Forest Administration for the year 1949-50, thamin are reported from the following Forest Divisions:—

Katha West Forest Divisions.—Unclassed forests in Nam Khan Range.

Meiktila Forest Division.—Sadon, Nagar—Min. Khum, Myothit, Tagundaing, Satthwa and Meiktila Range.

Zigon Forest Division.—Satthwa Reserve. The Divisional Forest Officer, Zigon Forest Division informed, the writer in October 1953, 'thamin are on the increase in Satthwa Reserve, Gamon Range, as no one dare go out into the jungle to shoot game.'

The Deputy Commissioner, Yamethin District, informed the writer in December 1953, 'Thamin exist abundantly in Meiktila District though of course its number is gradually on the decline as it is one of the easiest of game to be shot. Their habitat spreads almost throughout the whole district and even extends into considerable areas of adjoining Kyaukse—Myingyan, Magwe and Yamethin Districts. It is found in good numbers all along the foothills and its sparsely jungled plains on the East of Kyaukse, Meiktila and

Yamethin Districts.' The Deputy Commissioner, Yamethin District was Sub-divisional Officer, Meiktila, before he was posted to Yamethin.

SHAN ROAD,
KEMMENDINE P.O.,
RANGOON (BURMA),
November 26, 1953.

TUN YIN

6. STRIDE OF ELEPHANT CROSSING TRENCH

On page 933, Vol. 50 of the *Journal* I recorded elephants crossing a 5½-ft. trench. This month an elephant on two successive nights, in a single stride, crossed and re-crossed an 8-ft. V-shaped trench bordering our raghi farm. From the tracks he would appear to have lurched himself over.

HONNAMETTI ESTATE,
ATTIKAN P.O.,
via MYSORE (S. INDIA),
October 29, 1953.

R. C. MORRIS

7. DEATH OF WILD ELEPHANTS, FROM SUSPECTED FOOD-POISONING, IN TRAVANCORE-COCHIN STATE

During October and November last year, there were several deaths among elephants in the Periyar Game Sanctuary area of the State Reserve Forests. Altogether eight elephants died, one on 13-10-1953, two on 10-11-1953, four on 16-11-1953 and one on 19-11-1953. Fearing the outbreak of an epidemic, the Disease Investigation Officer of the State Animal Husbandry Department was deputed to investigate the cause of this mortality. Upon arrival at the scene of death, he found that vultures and other carrion-feeders had already made short work of the carcasses and reduced them to bones and scraps of skin so that he could not secure any material for bacteriological or other examination. However, from the fact that there were no more deaths among elephants in that area after the last death was reported i.e., 19-11-1953 (there has been no further report up to the time of writing) and from the healthy condition of the five survivors of the herd that had sustained this mortality and which he found feeding in the neighbourhood, he ruled out the possibility of infectious diseases such as Anthrax, Rabies and Haemorrhagic Septicaemia. The absence of casualties among domestic cattle grazing in and around the place where two of the elephants had died, as welll as the fact that cuts and skin abrasions sustained by the labourers who were assisting at the post mortem of one of the animals healed up normally leant further support to this view. The possibility of insecticides and fertilizers used in the neighbouring tea-gardens as a source of poisoning was also considered, but it was reported that they did not contain enough poison to kill any of the higher animals, much less an elephant. Even if contrary to assurances, they did have any strongly poisonous substance, at least stray cases of death either then or previously, among cattle or elephants should have come to light, for insecticides and fertilizers have long been in use in these estates. With the above causes of mortality thus eliminated, there only remained the possibility of the elephants feeding on some poisonous plants. During the course of the inquiry, it transpired that some of the estate labourers had raised one or two crops of Koda millet along the border of the reserve forests. Can it, then, be that the elephants had raided these crops and got poisoned in the process?

Paspalum scrobiculatum Linn. the Koda millet is known occasionally to develop a narcotic principle which then becomes fatal to man and animals. Mr. R. C. Morris on page 722, Vol. 37 of this *Journal* has reported the instance of fourteen elephants dying from millet poisoning in the Vannathippara Reserve in South India. Tamarind and buttermilk are believed to be antidotes for this poison. Gruel made out of green gram meal, the juice of the stem of the plantain and the astringent juice of the guava are also reported to counteract its poisonous properties.

I am indebted to the Chief Conservator of Forests, Travancore-Cochin State and the Disease Investigation Officer for the information contained in this note.

'GOKULAM',
NANTENCODE, N. G. PILLAI
TRIVANDRUM,
February 6, 1954.

8. BIRDS EATING THE POISONOUS FRUIT OF THE YELLOW OLEANDER (*THEVETIA NERIIFOLIA*)

Further to my note on the Koel's addiction to this poisonous drupe in *J.B.N.H.S.*, Vol. 50, No. 4, pp. 943-944, and Mr. K. K. Neelakantan's record in Vol. 51, No. 3, p. 738, of the Common Grey Hornbill (*Tockus birostris*) eating the fruit:

On February 13, of this year, I saw a Common Mynah (*Acridotheres tristis*) pecking at the fallen drupes on the ground beneath the tree and consuming the fleshy mesocarp. In the last three months I have again noticed Koels eating the fruit, and a Common Mynah pecking at a fallen fruit.

LECTURER IN GENERAL SCIENCE,
GOVERNMENT TRAINING COLLEGE, S. M. KRISHNAN
MANGALORE,
December 28, 1953.

9. MIGRATION OF INSECTIVOROUS BIRDS IN MADHYA PRADESH IN 1953

The rains of 1951 and 1952 were much below normal in the west of Madhya Pradesh comprising the districts of Hoshangabad, Betul, Nimar, Buldana, Akola, Amravati and Yeotmal. Upto the end of the hot weather of 1953 there was no marked change in the usual distribution of birds but from the onset of the rains about June 15 there was a strong migration. By the beginning of July most insect-eating birds had gone. The most striking example was the Green Bee-eater (*Merops orientalis*). Except for a few birds on the Narmada I did not see any resident birds in the seven districts until October. About the middle of July I saw two parties of Bee-eaters but these were on the move and did not stop. I had previously recorded that the Bee-eaters left the higher plateau areas in the rains: for instance they are absent from Betul from July to September, but this is the first time I have seen them leave the plains in the rains. I noticed the return migration on October 1st and by the end of October numbers were normal. The other insect-eating birds were also present in much fewer numbers but their withdrawal was not complete. The next most common insectivorous bird, the King-Crow (*Dicrurus macrocercus*) was not seen for miles on end but in some centres there were several individuals. The Blue-Jay (*Coracias benghalensis*) was rare: Shrikes were seen and their numbers fell less than any other. The Fly-catchers, such as the Whitebrowed Fantail Fly-catcher were not seen by me. The only insect-eating birds which seemed to be present in usual numbers were the Indian Swift (*Micropus affinis*).

In many drier parts, for instance in Khandwa town the only birds seen were Crows, Mynahs, Doves, Sparrows, Swifts and Larks.

I toured in the above area only and cannot say how much further eastwards the migration occurred.

CONSERVATOR OF FORESTS,
AMARAVATI CAMP, C. E. HEWETSON
BERAR,
January 5, 1954.

10. STRANGE BEHAVIOUR OF A HOUSE CROW

The behaviour of the crow referred to on page 939, Vol. 50, No. 4, would suggest that it was hiding something for future consumption and an inspection immediately after the incident may have explained just what it was doing.

I witnessed a very similar incident in Malabar from a distance of about 20 or 30 ft.; the crow in this case was watched while it carefully hid a fairly large piece of a rice cake under the lower edge of a wooden railway sleeper in a track adjacent to the one on which my railway saloon was stabled.

The crow flew to the spot and deposited the food which it had in its tightly packed beak. It next poked round near the underside of the sleeper and removed two or three stones which were resting loosely against the sleeper and formed part of the stone ballast of the track. The food was then placed in a small recess and the stones replaced. It then hopped a few feet away and picked up two or three dry leaves which were pushed in near the stones. The bird was very silent during this time and when it appeared satisfied it flew away.

It returned again in a few minutes and did some rearranging of the stones and leaves, but did not appear to bring any more food.

c/o The Imperial Bank of India,
25, Old Broad Street,
London, England,
October 22, 1953.

C. H. BIDDULPH

11. POSSIBLE ASSOCIATION BETWEEN THE LARGE YELLOW-NAPED WOODPECKER AND THE LARGE RACKET-TAILED DRONGO

Lt.-Col. Bates' note on page 941, Vol. 50, No. 4, is of interest as it would appear to place on record yet another instance of the more common associations that exist between birds and animals, or birds and natural phenomena with which we are familiar. Associations which may be considered as of convenience and mainly connected with the easier procurement of food.

Associations that are more commonly known are:—

(*a*) Cattle Egrets and Grazing Cattle.

(*b*) Indian Rollers, Drongos and Shrikes in advance of a small jungle, or scrub fire.

In both these instances the birds appear to realise they will be able to procure food more plentifully and with less effort.

In the first instance cattle while grazing disturb insects that would otherwise have remained hidden and in the second the insects that try to escape the fire are readily captured by the birds waiting just in advance of the fire.

The probable explanation of the association witnessed by Lt.-Col. Bates owes its origin to the fact that both these birds are insectivorous and that the woodpecker in climbing the trunks of trees in search of insects on which it normally feeds inadvertently disturbs certain winged insects which in flying away are seen and captured by the attendant and very alert drongo.

The drongo would find it a slower business procuring insects in the ordinary manner in a thick jungle and any assistance afforded by a foraging woodpecker would be made good use of on occasions when both birds happened to be feeding in the same locality.

It seems unlikely that the drongo would continue to follow the woodpecker throughout any prolonged period, but it is evident from the instances now recorded that when these two species meet the drongo does seem to recognise a bird that is of assistance to it and makes the most of the opportunity to do some quick feeding.

c/o The Imperial Bank of India,
25, Old Broad Street,
London, England,
October 22, 1953.

C. H. BIDDULPH

12. *CUCULUS CANORUS BAKERI* IN BOMBAY

On 12th October, 1952, I motored up to the Randha Falls near Bhandardara, Ahmednagar District, Bombay State, where cuckoos appeared to be common. I obtained a specimen which I was unable to match with any of the birds in our collection but it has now been compared by Dr. S. Dillon Ripley with the material at the American Museum of Natural History, New York, and he has placed it as nearest to *Cuculus canorus bakeri* which was described from Shillong, Khasia hills, Assam. The specimen, a female, has the following measurements:—

Wing	...	...	198 mm. (fresh)
Bill	...	...	22 mm. (from base)
Tarsus	...	...	21 mm.
Tail	...	...	142 mm.

These measurements are smaller than those recorded for *bakeri* (Fauna IV p. 139 exceptionally small female 208 mm., mostly between 225 and 235 mm.) and the specimen also represents a very considerable extension on the known range of this race which has been believed to be more sedentary than the others.

Faiz & Co.,
75, Abdul Rehman Street,
Bombay 3,
February 1, 1954.

HUMAYUN ABDULALI

13. OCCURRENCE OF REDWINGED CRESTED CUCKOO (*CLAMATOR COROMANDUS*) IN MADRAS

The Redwinged Crested Cuckoo (*Clamator coromandus*) is definitely a bird that visits the neighbourhood of Madras in the rainy season. I saw two dead specimens with a Kurava in 1950, I think it was in August, and in September last a boy brought me a live specimen, unfortunately with a leg broken and a wing also maimed—he said he had obtained it in Chembarambakkam, an immediate suburb of Madras City, and when I tried to get 'fuller and better particulars', as the lawyers say, he ran away with his victim. There are three specimens of this cuckoo in the Madras Museum, all collected near Madras City. I am almost sure I have seen this bird near St. Thomas Mount, but had only a fleeting glimpse. In Madras, as elsewhere, the bird is partial to a woodland habitat.

Lecturer in General Science,
Government Training College,
Mangalore,
December 28, 1953.

S. M. KRISHNAN

14. GOSHAWK (*ASTUR GENTILIS*) IN BHAVNAGAR (SAURASHTRA)

Fourteen years ago, His Highness the Maharaja Saheb Sir Krishnakumarsinhji of Bhavnagar felt sure that he had seen a male adult Goshawk in the Victoria Park, Bhavnagar. It was much doubted whether this observation by His Highness was quite correct, because no wild Goshawk had been reported in Kathiawar. However, owing to His Highness' experience in falconry, the record was reluctantly accepted. Fairly recently, I myself, was quite sure of having seen an adult female Goshawk in the Gir forest in the winter of 1949. Both the above records were sight records, and therefore, were subject to questioning. However, this year on 10th December, 1953, His Highness the Maharaja Saheb of Bhavnagar's men caught an immature female Goshawk in perfect plumage in the Victoria Park, Bhavnagar. This is conclusive evidence that this species migrates into Saurashtra, and that the previous sight records can now be considered validated.

Identification of the bird was confirmed by the fourth quill being longest, the tail long and rather graduated with the tarsus about equal to tibia in length, the former being scutellated in front and behind and reticulated on the sides. The right wing measured 340 mm. and the left 343 mm.

'Dil Bahar',
Bhavnagar,
February 14, 1954.

K. S. DHARMAKUMARSINHJI

15. OCCURRENCE OF THE BANDED CRAKE [*RALLUS EURIZONOIDES AMUROPTERA* (JERDON)] IN TRAVANCORE

Mr. W. H. Matthews' note [*Journ., Bombay Nat. Hist. Soc.*, 51 (3): 742] on the nesting of the Banded Crake in a tea bush in Darjeeling causes me to wonder if this species does not breed also in tea estates of the Vandiperiyar district of Travancore (elevation 3,000 ft.). Although the species is distinctly rare in this district I have observed it on several occasions in the months April-July during the past six years. These birds are usually seen singly and are generally only seen when put up by dogs as they skulk under tea bushes. I have not seen any sign of the species breeding in the area but on two occasions I have seen a pair of birds together, so I do not rule out the possibility. The Banded Crake appears to be absent from this area for the rest of the year, and it may be that the birds that I have seen have been stragglers which have been blown in from the coastal areas by the S.W. monsoon winds.

Munjamullay Estate,
Vandiperiyar P.O.,
U.S.T.C.,
November 4, 1953.

M. C. A. JACKSON

[The Travancore and Cochin Ornithological Surveys failed to meet with this bird. Sálim Ali in his report on the Surveys (*Journ.*, *Bombay Nat. Hist. Soc.*, Vol. 39, p. 574) writes:—

> 'Ferguson (*J.B.N.H.S.*, xvi, 5) procured a single specimen of this crake in 1875 in some paddy fields near the foot of the hills in South Travancore at about 400 ft. elevation. There is, according to Mr. Whistler, one Travancore specimen labelled "Mynall" with no other data in the British Museum (Hume Collection), and a second also without data, collected by Fry. It occurs in Ceylon.
>
> *Breeding.*—No information available for Travancore or Cochin.'

Mr. Jackson wrote in later to say that he had seen this species again on 22nd November.—Eds.]

16. FOOD OF THE BULL FROG

This letter is many years over-due. I could find many excuses, but honesty would reject them all, leaving only sheer inertia.

The District Judge of Ratnagiri lives in a delightful old rambling sandstone house, of which the ground floor is his Court and Office. From the residential verandas one looks down on to a charming garden backed by a patch of forest. A bird-bath which I chipped out of a sandstone block and sank almost flush with the ground used to give me hours of fascinating entertainment.

Near the centre of the garden there is a small deep rectangular tank—the mali's water storage point. A Whitebreasted Kingfisher had a habit of plunging into this tank every afternoon (presumably for fun or refreshment, since there were no fishes in it). And a huge Bull-frog used to squat in the grass at the side of the tank (which was totally sunk in the ground) all day long.

One afternoon, as I studied some case-papers, my daughter came running to me with a very bedraggled Kingfisher in her hand. She had heard a frantic splashing in the tank, and on going to investigate, she found the Kingfisher in the water, all but drowned, tightly clasped by the bull-frog from behind. Evidently the frog had leaped on the bird's back exactly as it dived, and had gripped it round the wings so that it could not escape—a real wrestler's hold! My daughter and I carefully dried the Kingfisher and placed it in the sunshine; after an hour it flew away. The bull-frog was sentenced to banishment from the garden, the sentence being carried out forthwith.

What was the frog's intention? Did he plan to eat the bird? If so, he might doubtless have avenged the deaths of countless small cousins and remoter relatives. But how would he have digested that formidable beak? Have you a record of any similar murderous onslaught?

'Sevagram',
Bhangarwadi,
Lonavala Dist.,
Poona,
December 24, 1953.

T. GAY

[The bull frog is omnivorous and we have, from time to time, recorded various items as its food. They include snakes, garden lizards, toads, a wounded snipe, sparrows, Guinea fowl chicks, rats, mole crickets and also the cocoon of a psychid moth made of sharp babool spines, ¾ in. in length, with larva inside. We have, however, no record, of a frog clasping its prey in its arms!—EDS.]

17. THE RECORD INDIAN CROCODILE

Major W. Robert Foran in the *Field* dated January 13, 1951, p. 61 dealt with the records of large crocodiles in Africa and wrote:—

> 'A normal specimen is roughly seven times the length of its head. An alleged 40 ft. one, therefore, would have a head about 6 ft. in length, which is the height of absurdity . . . .'

The evidence for the largest Estuarine Crocodile (*Crocodilus porosus*) was a skull in the British Museum from Bengal and which was said to have been taken from an animal measuring 33 ft. in length. We wrote to Dr. Malcolm Smith asking for its measurements and his reply reads:

> It measured 33½ in. which is 1/12 of the total length, if 33 ft. as stated, is correct. There is no reason to think that the African crocodile differs greatly in proportions from that of *C. porosus*.'

If Major Foran's method of calculation is correct the alleged record specimen would have been only 19 ft. 5 in. in length and not 33 ft. We have examined two Marsh Crocodiles (*C. palustris*) in Bombay, one juvenile 290 mm. and one adult (10 ft. 5 in.) and their heads measure between ⅙ and 1/7 of their total length.

114, APOLLO STREET,
BOMBAY,
December, 1953.

HUMAYUN ABDULALI

18. AN ADDITION TO THE LIST OF SNAKES OF BOMBAY AND SALSETTE—*UROPELTIS MACROLEPIS* (PETERS)—UROPELTIDAE

On the 2nd July 1953, Mrs. Roshan Captain sent in a specimen of the Roughtailed Earth snake—*Uropeltis macrolepis* (Peters) obtained in a garden at Powai Lake, Salsette Island, Bombay. This species has not been recorded previously from Bombay and Salsette Island.

Some potted plants had just been received from Bangalore, but Mrs. Captain assures us that the snake was picked up about 30 yds. away and could not have arrived in this parcel.

It is interesting to note that this specimen has the characteristics of those localised at Mahableshwar as recorded in *J.B.N.H.S.*, 50, p. 950 and 51, p. 512, i.e. a lemon-yellow stripe occupying 2 scalerows on either side as also 12-13 subcaudals.

Subsequent to this Dr. K. K. Nair of Wilson College, Bombay, sent in one more specimen from Mahableshwar which agrees with these.

The distribution of the two forms appears curious when it is recalled that specimens from Lonavala, Khandala, Igatpuri and Matheran, are identical and differ from those from Bombay and Mahableshwar.

BOMBAY, V. K. CHARI,
December 28, 1953. *Officiating Curator.*

19. FURTHER COMMENT ON THE MANI-JAL OF THE CHILKA LAKE—A SPECIAL NET FOR BELONIFORM FISHES

Commenting on a note by us published in the Society's *Journal* (Vol. 51, No. 1, pp. 288-289) on the Mani-jal of the Chilka Lake, Mr. M. Peter Devasundaram states [*J.B.N.H.S.*, Vol. 51 (3): p. 761] that Hornell in his account of the fishing methods of the Madras Presidency (*Mad. Fish. Bull.*, Vol. 18, No. 2, p. 73) 'has described the same net under the name 'Kuzhi Valai' used in the Negapatam backwaters' and that Hornell 'has also stated that it is exclusively used for catching the garfish, *Belone strongylurus*'. A careful perusal of the description of Kuzhi Valai by Hornell and of Mani-jal by us would show that the two are different and that Hornell does not state that the Negapatam backwater net is used for catching garfish.

Mani-jal, as we have stated, is a composite net 'made up of a chain of small bags' each distinct from the other, whereas Kuzhi Valai according to Hornell is a 'peculiar modification of the normal Konda Valai, where the bag is no longer continuous but is broken up into as many small pouch-like bags as there are vertical sticks' placed 'across the common mouth of the net'. Though Hornell has not stated that the net is used for catching garpike in Negapatam it could presumably be used with almost the same effect as the Mani-jal of the Chilka Lake or the Kola Valai of the Coromandel Coast.

Hornell, however, says that nets of similar design as Kuzhi Valai but 'much longer and rather deeper in the mouth are used at Kundapur in South Kanara where they are employed to catch garpike (*Belone strongylura*)' and adds that 'so far as I am aware this much-specialised net is not known at any other places in the Presidency'. In the absence of further information about the construction of the net it cannot be asserted that it is the same as the Mani-jal.

The Kola Valai, the Konda Valai, the Kuzhi Valai, the 'garpike net' of Kundapur and the Mani-jal show varying degrees of relationship amongst themselves, but in the present state of our knowledge the origin and evolution of these nets could only be a matter of speculation.

CENTRAL INLAND FISHERIES
RESEARCH STATION, S. JONES
BARRACKPORE, K. H. SUJANSINGHANI
October 14, 1953.

The above was sent to Mr. M. Peter Devasundaram who writes:

> 'I have no further comments to make on the subject as Dr. Jones and Mr. K. H. Sujansinghani have admitted that "Kuzhi Valai of Hornell's description could presumably be used with almost the same effect as Mani-jal of the Chilka Lake." It is clear from Hornell's description of Kuzhi Valai that the bag is not continuous but broken up into as many pouch-like small bags as there are vertical sticks crossing the mouth by which he means that the mouth of the net is one and not many.'

[Hornell's sketch appears to confirm that Kuzhi Valai consists of a series of pouches which are, however, said to be 30 in. deep as compared with 15 in. for Mani-jal.—Eds.]

20. APOSEMATIC INSECTS AND THEIR FOOD-PLANTS

Mr. McCann's note under this heading (*J.B.N.H.S.*, Vol. 51, p. 752, 1953) rather tends to overlook the essential difference between insects with an incomplete metamorphosis, and with the same food-plant in both the immature and adult stages, and those where the metamorphosis is complete and the food in the two stages entirely different.

Aposematic lepidopterous larvae, feeding on poisonous food-plants, are undoubtedly protected by their poisonous qualities, although I am more inclined to the view that it is through the remnants of food in the intestinal tracts rather than an actual absorption by the tissues. Poulton records an instance where a procryptic larva feeding on Ivy was rejected by birds, but accepted readily when transferred to a non-poisonous food-plant. I have not got the reference with me but, from memory, the larva was *Biston betularia* L., the birds domestic fowls.

During the pupal stage of Lepidoptera there is an almost complete break-down of the larval substance and a rebuilding into the adult. Pigments that were present in the larva disappear and new pigments are developed, and I think it highly probable that any poisonous constituents derived from the larval food-plant would do the same. So far as I know, there is no known larval mutant that is connected with an imaginal one. Thus the green and brown forms of Sphingid larvae both produce the same form of imago. There is an English Geometer with two larval forms with the fat and blood of different colours, but the imago from both is the same. I have recently discovered an African Lymantriid (*Dasychira georgiana* Fawc.) in which in addition to a dimorphic larva, there is also a sex-controlled dominant in the female larva; the larvae either being black or green, with the female larvae also either having or lacking an orange-red lateral stripe, which never appears in the male larva. All larval forms produce the same imago.

The Pierid, *Catopsilia florella* F., has two larval forms that appear to be directly connected with pigments derived from the food. When feeding on the leaves of Cassia they are green, when feeding on the yellow flowers they are yellow, but both forms of larva turn to the same clear, greasy-looking green when preparing to pupate and both produce the same green pupa. Here, then, is a case where the larval pigment does not persist in the pupal stage even.

Much of the above may appear to be beside the point at issue, but pigments have been studied to a certain extent and many of them analysed and it does not seem unreasonable to assume that the other compounds that go to make up an insect behave in the same way.

To return to Mr. McCann's note, he states in his remarks on Lepidoptera that *Danaus chrysippus* has a scent similar to its food-plant, Asclepiadaceae of various species. But does it? Dr. G. B. Longstaff, who probably studied the question of Butterfly scents more thoroughly than anyone before or since, writes that the scent in both sexes is of a strong and disagreeable nature, like that of cock-roaches, and adds that it has also been compared to the scent of musk-rats (*Butterfly Hunting in Many Lands*, 494). Dr. Longstaff was obviously well acquainted with *Calotropis*, the usual food-plant of *chrysippus*, as elsewhere in the same book is the remark that the absence of the Danaid was surprising in view of the abundance of *Calotropis*. In all his references to the scent of *chrysippus* stress is laid on the animal nature of the scent, whereas most other groups have scents reminiscent of flowers. As regards *limniace*, Longstaff writes:—

> 'I detected in a male a very faint scent suggesting old cigar-boxes. Observations made on other occasions were doubtful or negative.'

KAMPALA, D. G. SEVASTOPULO, F.R.E.S.
November 15, 1953.

21. APOSEMATIC INSECTS AND THEIR FOOD-PLANTS

Mr. Sevastopulo believes that I have overlooked the difference between insects with complete and incomplete metamorphosis, the latter (often) feeding on the same food-plant throughout life, but I can assure him that this point did not escape my attention. My first example, *Aularches*, (incomplete metamorphosis) feeds on plants of two different families, one in the hopper stage, and the other in the adult stage. Both hopper and adult reflect the odour of their respective food-plants. In this particular instance the two plants are not available at the same time of the year. In the case of *Poecilocerus*, the food-plant is available throughout the year. In the case of *Lepidoptera* (complete metamorphosis) it is obvious that the food supply should vary from larvae to adult owing to the complete transformation of the mouth parts. The odour of the crushed or bruised insect is different to that emitted by the special (often plumose) scent glands. If such scents are elaborated from its larval food supply (?) it seems also possible that the odour of the food-plant can be retained in adult life as a means of protection from would-be enemies. The scent from the specialized glands (although they may also play a role in protection) appear more in the nature of devices for the attraction of the sexes rather than for purposes of protection. It is the odour of the body (or poisonous property of the body) which acts as the deterrent and this, it seems reasonable to believe is derived from the food-plant of the larval stage.

In his second paragraph Mr. Sevastopulo admits that aposematic lepidopterous larvae are 'undoubtedly protected by their poisonous qualities,' but qualifies his admission on the grounds that he is inclined to the view that 'it is through the remnants of food in the intestinal tracts rather than an actual absorption by the tissues.'—belief without any positive support for his contention, but which I leave open to question. In support, Mr. Sevastopulo refers to a record of Poulton's on procryptic larvae being rejected or accepted by domestic fowls, when the larvae are fed on noxious and innocuous food-plants. My main objections to the results of Poulton's experiment (as given by Mr. Sevastopulo) are: (1) What is the normal natural enemy cycle of the larvae in question? (surely not the domestic fowl!): (2) The use of the domestic fowl—as a gallinaceous bird it is predominantly granivorous, although it will accept almost anything, and is probably less selective in matters of food than its wild congeners. Domestication tends to make animals more 'careless'): Does not the feeding on poisonous plants tend to protect and enhance the security of the species rather than those larvae which feed on non-poisonous plants and are therefore more readily acceptable to would-be enemies? Presumably, the innocuous larvae would be susceptible to a greater enemy cycle than the noxious ones, and on that account alone, would, in time be, perhaps, exterminated. A further question which may not have a direct bearing on the subject is: Which way is the species tending, towards the poisonous food-plant (for security) or towards a non-poisonous food-plant? However, these points may appear just quibbles but, I think, are factors which cannot be lost sight of.

My original note on the above subject was intended merely as a record of my own experiences and observations in the field, and the interpretation of the scents as diagnosed by *my nose*. Scents, more than colours, are difficult to define, and the individual can only refer to them as 'like so and so'—a past 'scent memory' based on previous experience—the odour in question recalls to mind some particular object which emitted a *similar* odour. When two persons, or more are subjected to the same odour, their responses and comparative 'scent terminology', may be totally different, governed, partly by the degree of sensitivity of their respective noses, and partly by the 'memory' of scents they have previously encountered. The second factor is more important for the 'memory' is limited by the past experience of the individual. An odour in concentration may be pleasant to some and nauseating to others. In reduced degrees of concentration the terminology may vary very considerably. There is too much individualism to be accounted for, for accuracy.

It is well-known that a prolonged stay in a scented atmosphere results in the individual becoming 'immune' to the particular odour to which he has become accustomed and can 'smell' it no longer, while his nose remains sensitive to fresh odours in the same atmosphere. Scent terminology is almost impossible, for example, let us take the word *musk*—there are many degrees of 'musk' and as many interpretations of what is 'musky'. Animals have been variously referred to as Musk-Deer, Musk-Rat, Musk-Shrew, and so on. The odour of many reptiles and cockroaches, and several other insects, have been referred to as *musky*. However, (to *my* nose) all these various *musks* are very different, I would prefer to prefix them as occasion arose. As a botanist I have often resorted to scent for the determination of a plant, and practised tracing plants at night by the scent of their flowers with fair success. This practice has given me a fair amount of scent appreciation and 'scent memory'. The terminology of scents is very controversial, even more so than colour, and I am not prepared to carry the controversy further. It would be less fruitful than the famous 'White Bison' correspondence which ran through the pages of the *Journal* some years back.

Although this discussion on 'scent terminology' and 'scent memory' has no direct bearing on the subject in hand, it tends to show how scents may be differently interpreted by different individuals. In the absence of some definite method of evaluating scents, argument leads nowhere. Each observation is individual and individually interpreted. It was in this spirit that my original note was published.

DOMINION MUSEUM,
WELLINGTON, C. McCANN
NEW ZEALAND.

22. OCCURRENCE OF *DANAIS CHRYSIPPUS* VAR. *DORIPPUS* AT DUM DUM AIR PORT

I have to record that on the 27th December, 1953, I took a specimen of *Danais chrysippus* var. *dorippus* in the garden of my shack, two miles north of Dum Dum Air Port.

The butterfly is, I believe, very rare in this part of India and may be worth recording in the *Journal.*

c/o GRAHAM TRADING CO. (I) LTD.,
6, LYONS RANGE, A. E. G. BEST
CALCUTTA,
February 20, 1954.

[*D. chrysippus* var. *dorippus* occurs only sporadically within our limits. It has been taken at Campbellpur in the Punjab, at Karachi, near Poona, in the neighbourhood of Trincomalee, Ceylon and recorded from the Southern and Eastern coasts of the same island.—EDS.]

23. HUNTERS' SUGAR

When I was hunting big game with my Burman hunters in the year 1889 or thereabouts in the forests of the Momeik State Ruby Mines District, Upper Burma, one of my hunters who was with me on this occasion suddenly pointed out a bush to me growing in the jungle about 4 ft. 6 in. in height which was covered with a thick white semi-hairy looking substance which looked to me like hoar frost and remarked to me, 'Sir there is a bush which is covered with hunters'. sugar'. Being somewhat sceptical about this I ran the fore finger and thumb of my right hand along one of the stems of the bush containing the white substance referred to and noticed at once after tasting it that it had a distinctly sweet taste and flavour of sugar and it was not till I was in Dehra-Dun, India, during the last war against the Japs, many years afterwards, that I touched on the subject in a letter to Father Caius who was an editor of the *Journal* and from whom unfortunately I never received any reply on the subject of the Hunters' Sugar tree.

It was only the other day that my brother-in-law, Mr. R. M. Aldworth informed me that he had come across a similar bush in the jungle sometime ago covered with the same snow-white feathery substance which I had seen and which he took to be the 'larvae' of some insect or moth which may probably be the correct solution.

He did not, he informed me, taste this white feathery substance but got a Shan villager who was on the spot to do so for him and who said that it was very sweet.

There was one other thing that one of my hunters showed me about this time which also rather astonished me. He picked up a piece of smooth green-coloured creeper a little thicker than an ordinary lead pencil and after cutting off a portion of it, about ten inches in length, dropped it into a small stream that was flowing alongside us at the time. The cut portion that had been dropped into the water then started to swim off as if it were a live snake. This was referred to by Burmans as the 'Nwe-Shin' or live creeper.

TAUNGGYI,
S.S.S.,
BURMA,
November 25, 1953.

W. S. THOM,
Retired Imperial Police.

[The sugary secretion is usually associated with certain Coccids (scale insects) and allied families of the Hemiptera; the young stages, which are flat, secrete both the sugary substance as well as wax which covers the entire body and is sometimes produced into hair-like prominences.—EDS.]

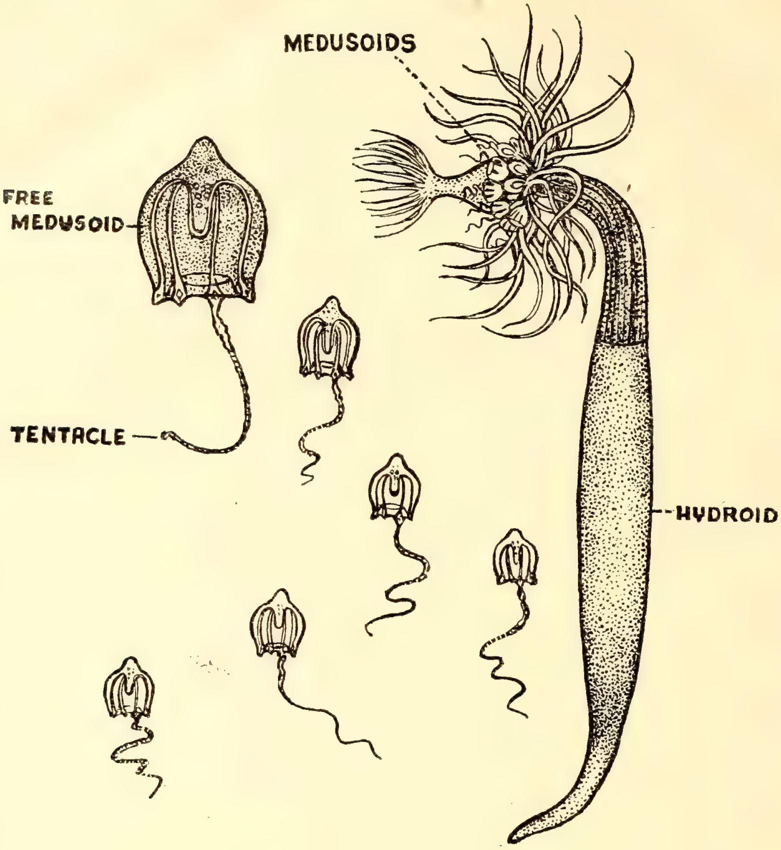
24. OCCURRENCE OF CORYMORPHA (*HYDROZOA*) IN INDIAN WATERS

(*With a text figure*)

In August 1953, an outing by the author to the shore at Colaba for the collection of specimens for the Taraporevala Aquarium, yielded a number of beautiful solitary hydroids in a bed consisting of both a sandy and muddy layer. The specimens were brought to the aquarium and were kept in exhibition tanks with proper aeration. Some of these specimens were preserved in 4% formalin for later study. The hydroids were identified as a new undescribed species of Corymorpha.

Reference was made to the Zoological Survey of India for literature and for information on the distribution of genus Corymorpha in Indian waters. The inquiry shows that Corymorpha had not been previously recorded in any part of India and that its discovery in Bombay was significant.

Corymorpha is solitary in habit and grows to nearly 2½ in. in length. It carries two clusters of tentacles, the lower set being thicker, while the upper set encircling the mouth has the fineness of threads. Lying at the base of the thicker tentacles is a ring of branching gonophores with medusae in different stages of development. These medusae had detached themselves from the parents and were moving freely. The body of the animal is slender and bulbous below and has a root-like structure with which it embeds itself in the sand.



CORYMORPHA SP. (DIAGRAMMATIC)

Four days after the introduction of the Corymorpha in the tank, tiny medusae were extruded by the parents and were seen swimming in the tank. The medusae resemble roughly the shape of a lantern, with a typical cone, surmounting the dome. It had but one tentacle, beaded in appearance owing to the presence of nematocysts.

TARAPOREVALA MARINE
BIOLOGICAL STATION,
BOMBAY 2.

M. R. RANADE, M.SC. (Hons.)

25. A SIX-LOCULAR CAPSULE ON THE COTTON PLANT

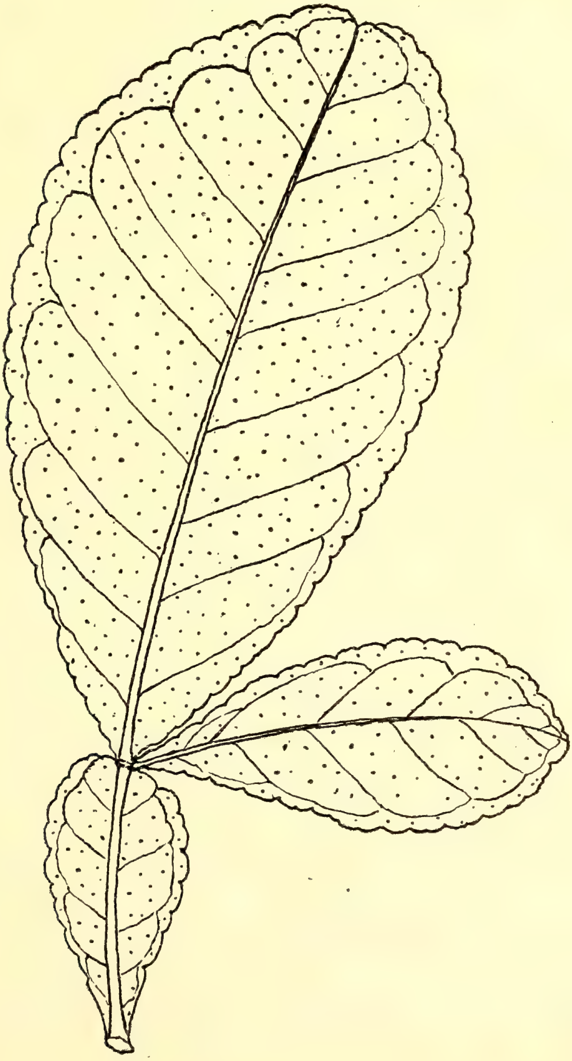
The cotton plant is known to bear 3-5 locular capsules. I found in our compound on 7-12-1953 a 6-locular capsule on a Devkapas (*G. Hirsuta var. brasiliense*) plant.

'SANJEEVAN',
ELLIS BRIDGE,
AHMEDABAD 6.

G. W. DEODHAR

26. OCCURRENCE OF A BI-FOLIATE LEAF IN *CITRUS AURANTIUM* L.

(*With a Sketch*)



The members of the genus *Citrus* (Rutaceae) are, 'Palaeo-tropical and sub-tropical perennials with usually simple leaves which show a joint at the meeting of blade and stalk indicating their derivation from compound leaves'. That is, in other words, the leaf of *Citrus* appears to be phylogenetically compound but has become unifoliate by reduction and often it is difficult to convince the junior students in the demonstration classes about this fact.

A large consignment of *Citrus aurantium* L. plants had recently arrived at the Chidambaram Railway Station from a certain nursery. While glancing through them cursorily, my attention was drawn towards a leaf which was bifoliate. This although an abnormal specimen, was a clear demonstration that the leaf of *Citrus aurantium* L. was phylogenetically compound. This abnormal compound leaf was quite normal in all respects with regard to the venation serration of the margin and the distribution of gland dots. The only difference observable was that a leaflet was borne in a lateral position at the very same joint of the large terminal leaflet and the broadly winged petiole (see figure). The laterally formed leaflet was about half the size of the terminal leaflet. The venation in this leaflet as well was of the usual type.

DEPARTMENT OF BOTANY,
ANNAMALAI UNIVERSITY,
ANNAMALAINAGAR,
October 12, 1953.

S. KALYANASUNDARAM

27. PROLIFERATION IN GRASS

Teratological phenomena are not very common in the grasses. As far as known no such cases have as yet been reported from Bengal. Goebel (1900) and Bor (1953) have cited examples of some viviparous species of *Poa* and of other grasses where flower or seed formations are often replaced by the growth of the axis of the spikelet into leafy shoots. Such shoots are capable of producing new offsprings. Another case of proliferation in *Sorgum* was reported from America by Lande and Gates (1929). In India S. A. Parandekar (1950) has reported such occurrence in *Zea mays*. The species of *Saccolepis indica* (L) A. Chase, *S. myosuroides*, A. Camus, collected from the neighbourhood of Birnagar and Chakdah District Nuddea, are found to contain many greatly proliferated spikelets. In order to see whether related structures of the spikelets can be traced, they are dissected and studied under binocular microscope.

The glumes, lemnas and paleas are seen to be transformed into leaf-like structures. The stamens and carpels are represented by the flat, green and elongated bodies. The cavity of the ovary is often found to be occupied by a larva or an egg of an insect. In *Panicum trypheron* Schult, inside enlarged ovaries such eggs are occasionally met with but proliferation is not the rule with that species. Curiously, though large number of spikelets are dissected out, yet no structures referable to the lodicules, are found out. Sometimes, however, a papery structure is found to remain attached to the style—the morphology of which is not clear. Another interesting fact is that in transformed lemnas or glumes, the number of veins characteristic of the particular species remain unaltered. About the reason of the proliferation it seems logical to suggest that the injury caused by the insects at the time of laying their eggs inside the ovary is responsible for the phenomena.

DEPARTMENT OF BOTANY,
VIDYASAGAR COLLEGE, R. B. MAJUMDAR
CALCUTTA 6,
December 7, 1953.

28. THE FLOWERING OF *STROBILANTHES AURICULATUS* NEES.

Strobilanthes auriculatus Nees, has flowered gregariously this year in the Singhbhum forests. The first flowers were noticed early in December, and the maximum flowering density was attained about the third week of December, and continues to be so. The flowering is confined to the Saranda, Kolhan and Porahat Forest Divisions, over an area of approximately 850 sq. miles.

The last gregarious flowering occurred in the same area in the cold weather of 1945-46, and as it is supposed that the period of flowering is six years the next gregarious flowering was expected in 1951-52, but it did not occur then. Sporadic flowering was, however, noticed in the cold weather of 1951-52, and to a greater extent in the cold weather of 1952-53.

Authentic records of previous gregarious flowering in this region of this species are: 1898, 1911 (Haines); 1933 (Mooney); 1939 (S. S. Prasad); and 1945 (S. Ahmad). According to Haines the variety *Edgeworthiana* is more common than the type species in Singhbhum. He gives the distribution of this species in Bihar as Singhbhum, North Champaran, Gaya Ghats, Manbhum, Hazaribagh including Kodarma. Mr. S. S. Prasad, the present Chief Conservator of Forests, Bihar, mentions having seen this species in gregarious flower in the Khurchutta Range, Giridih Forest Division, in the Hazaribagh District, in the cold weather of 1952-53. The vernacular names of this species used locally are: *Hutid* by Kols; *Gada Kalha* by the Santhals.

Strobilanthes jeyporensis Bedd., with white flowers as described by Clarke in the FBI, has also been noticed in Singhbhum this year, occurring as isolated plants but strikingly noticeable amidst the massed blue flowers of the *S. auriculatus*. Haines had given the area of this as the neighbouring Mayurbhanj hills and the Eastern Ghats near Mahendragiri, both in Orissa.

The other species noticed had purple and red leaves with blue flowers. It may be *Strobilanthes dyerianus*, which is normally a cultivated species, but identification is not certain. It was found in the Tebo Ghats on the Ranchi-Chaibassa Road, at an elevation of roughly 1,700 ft. above sea-level.

Haines also mentions the *Strobilanthes scaber* Nees, as occurring in Purnea, Santhal Parganas and Singhbhum, but it has not been seen in flower by me.

c/o SAMI AHMAD ESQ.,
1, EUROPEAN BACHELOR'S QUARTERS,
DORANDA, P.O.,
HINOO, RANCHI,
January 8, 1954.

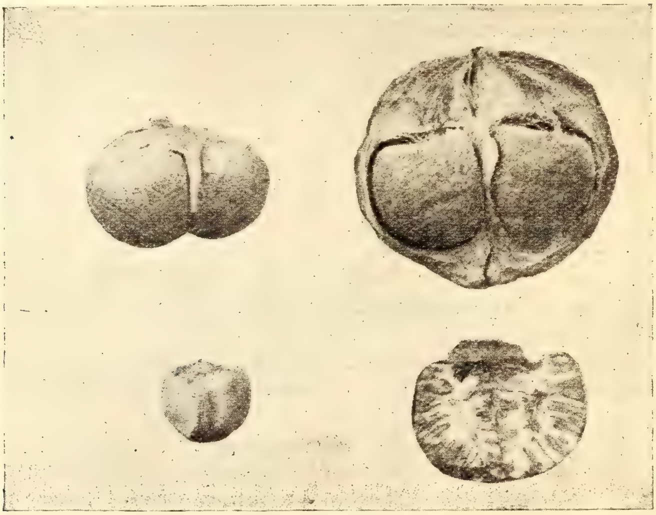
MRS. JAMAL ARA

29. ABNORMALITIES IN THE FRUIT OF *ARECA CATECHU* L.

(*With a text figure*)

Arecanut (fruit of *Areca catechu* L.) is normally one-celled and one-seeded. The pericarp of the young nut is green but turns to varying shades of reddish orange on maturity. This consists of a thin epicarp and a fibrous mesocarp. The endocarp is not so clearly differentiated or hard as in the coconut. The centrally placed seed completely fills the cavity and is adherent to the pericarp in the ripe fruit. But on drying it may separate and lie loose in the cavity. A vertical section of the seed reveals, at the base a short white cylindrical embryo, 2-3 mm. long and half as broad embedded in the endosperm. The latter consists of a central white portion from which many diverticula extend into the surrounding ruminate coloured area.

During the examination of a large number of arecanuts several abnormalities were brought to my notice by Sri. N. Balakrishnan, Senior Assistant, Arecanut Research Station, Vittal, South Kanara. They are described in this note.



One fruit though externally appearing normal was extrabroad. On opening, this was found to be two-celled with a distinct septum between the cells. In each cell was a well developed independent seed. Another fruit which did not exhibit any external peculiarity showed on cutting, an imperfect division of the cavity. There was partial development of the septum from the wall of the cavity towards the centre. But the two seeds had fused on one side. One of the seeds was bigger than the other. Each portion had a separate embryo. In a third fruit which was normal to all external appearance a double seed was present in a single cell. In this case the two seeds had fused all along the point of contact. But two distinct embryos were found each embedded in its portion of the endosperm. Other instances of double seeds were also noticed in which the two portions were of unequal growth.

Abnormalities in the fruits of coconut have been recorded by several authors, but there is no record of 2-celled fruits or double seeds in *Areca.*

AGRICULTURAL COLLEGE,
LAWLY ROAD, P.O., T. S. RAMAKRISHNAN
January 23, 1954.

30. EFFECT OF MARGOSA (*AZADIRACHTA INDICA*) LEAVES ON THE ROTTING OF POTATO TUBERS DURING STORAGE

Tandon[1] reported that the losses during storage of potatoes due to sprouting of tubers were low when the medium of storage consisted of sand and margosa leaves rather than sand alone. The present note deals with the effect of margosa leaves on the losses due to rotting of potato tubers during storage. The first lot of potatoes were stored between dry sand layers and in the second lot the storage medium consisted of a mixture of dry margosa leaves and dry sand. The rotted tubers were removed at definite intervals.

Table showing percentage of rotted tubers

Period of storage	Mean temperature of storage (°C)	Size of tubers	Sand + Sand	Sand + Margosa leaves
20 days ...	22·5	Small	0·14	Nil
		Big	Nil	Nil
40 ,, ...	26·9	Small	0·99	0·58
		Big	2·15	2·24
59 ,, ...	32·0	Small	1·70	1·02
		Big	6·45	5·61
90 ,, ...	33·8	Small	6·38	4·83
		Big	19.35	14·60
120 ,, ...	31·2	Small	18·86	8·78
		Big	36·55	17·96
150 ,, ...	27·7	Small	21·27	11·23
		Big	40·86	20·22
180 ,, ...	27·7	Small	23·50	11·23
		Big	45·21	20·22

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[1] Tandon, S. L. (1953) : *Curr. Sci.*, 22 : 255.

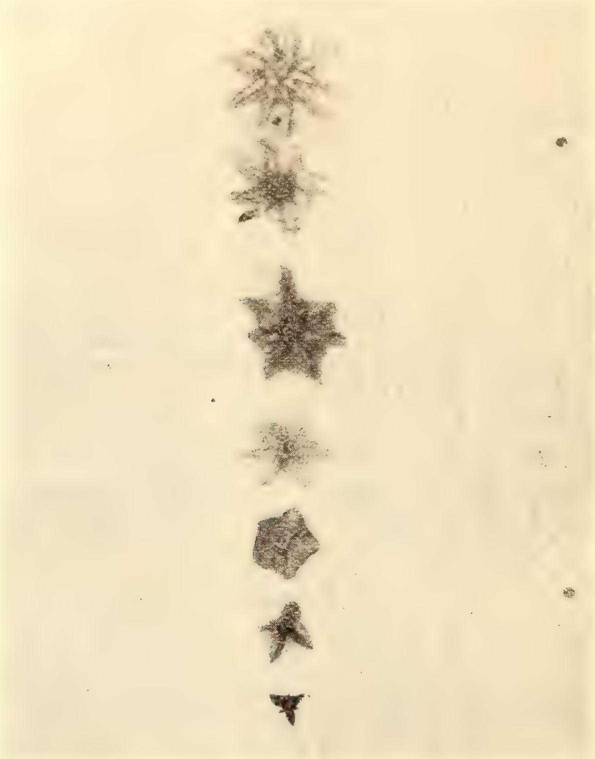
It is seen from the table that the losses in storage due to rotting of potato tubers was less when the medium of storage consisted of sand and margosa leaves rather than sand alone. These results, thus, further support the use of dry margosa leaves along with sand as storage medium for potatoes.

Department of Botany,
University of Delhi, S. L. TANDON
Delhi 8,
January 25, 1954.

31. VARIATION IN THE FLORAL PARTS OF *SOLANUM MELONGENA* L.

(*With a text figure*)

It is common knowledge that the flower of *Solanum melongena* L. belonging to the natural order *Solanaceae* consists of a gamosepalous calyx with five united sepals free in the upper part; a gamopetalous corolla with five united petals mostly distinguished by their separation at the tips; and five epipetalous, connate anthers alternating with the corolla lobes. Despite the above rule, six sepals and an equal number of petals and anthers per flower are not uncommon in the species.



Studies in the floral biology dealing with qualitative and quantitative characters of the floral parts have been reported from time to time. It is, nevertheless, proposed to mention in this brief note the extent of heteranthy obtaining therein due to the numerical variations in the floral parts.

A wild erect type of Brinjal yielding small round fruits is found to bear purple flowers with *three*, *four* and *five* sepals and as many petals and anthers as the number of sepals in individual flowers. In case of the 4-petalled flower the petals are entirely united, being distinguished by their paler colour and a marked venation in contrast to the deep violet colour of the floral membrane running right up to their tips and wholly uniting them, giving a squarish appearance to the open corolla; and the four stamens bear mostly four anthers, rarely a fifth one appearing fused with one of the four.

The above type of Brinjal appears to be perennial in nature. Of the 118 hard pendulous berries obtained during two seasons together, 76 were found to be five-sepalled, 38 were four-sepalled and 4 had three sepals only. Interestingly enough, roughly a direct correlation was noticed between the number of sepals and the size of the flower and the fruit, the mean diameter of the berries with five sepals being 1.94 cms., that of berries with four sepals being 1.83 cms. and that of berries with three sepals being 1.60 cms. The plants of this type are rather spiny and small leaved, the mean leaf size being about 4.5 x 3.0 cms. and the diameter of the flower varying from 2 to 3 cms.

In a Gujarat type of cultivated Brinjal we noticed flowers having five, six, seven, eight and nine long, slender and much separated sepals, their free portions approximating almost two-thirds of the length of the calyx; and as many petals and stamens in the flower, except that the following types of flowers are also occasionally evinced in this type:—

Type of flower	No. of sepals	No. of Petals	No. of anthers	Remarks on other irregularities of the floral parts
1	6	5	5	—
2	7	6	6	—
3	7	7	8	Four of the sepals found united into two pairs.
4	7	6	9	—
5	7	6	5	Two of the sepals being more united.
6	6	6	6	The sepals existing in three pairs instead of regularly alternating with the corolla lobes.

The flower of this type is large, the diameter of the open corolla being 4.7 to 5.3 cms., the large purple berry measuring approximately 10-12 x 9-10 cms. The leaf of this type is about 23 x 15 cms.

The 6- and 7-petalled flowers do not seem to be a rare occurrence and are mentioned here mainly for the sake of comparison with 3-, 4-, 8- and 9-petalled ones which are probably as yet unreported, the numerical range of these floral parts, which mostly bear a direct inter-relationship with one another, being, therefore, three to nine in the heteranthous species of *Solanum melongena* L.

We are indebted to Rev. Fr. H. Santapau for examining the specimens of flowers and the note.

AGRICULTURAL RESEARCH STATION,
BIJAPUR,
November 19, 1953.

G. P. ARGIKAR
M. S. SOLANKI

32. CHAPTERS ON THE HISTORY OF BOTANY IN INDIA, BY I. H. BURKILL, IN THIS *JOURNAL* 51: 846-878

A CORRECTION

In giving an account of the botanical work done in Western India (Vol. 51, p. 873) Burkill writes 'There was a botanically minded Charles Lush (1747-1845) at the Cantonment of Dopuri or Dapoli in the Ratnagiri District, with a Botanical Garden under his charge.'

This statement is obviously incorrect and needs correction. The Botanical Garden referred to was not situated at Dapoli in the Ratnagiri District but at *Dapooree* near Poona, in the grounds of Government House. It was formed by order of Sir John Malcolm in 1828 with an area of 48 acres (out of the 70 acres forming the whole Government House Estate) and was maintained at a cost of Rs. 3,600 per year.

The garden was established mainly for experiments in the cultivation of foreign cottons, coffee, tea, tobacco, Mauritius sugarcane, Mulberry, Cochineal insect, Culinary vegetables and fruit trees.

Three nurseries were attached to it at *Sheoneri Fort* (for temperate plants) and two at *Hirwe* and *Nirgori* both situated near Narayangaon.

This garden was successively in charge of Dr. Williamson, Dr. Lush and Dr. Gibson. The garden continued in this locality upto 1865 when it was shifted to Ganeshkhind along with the Government House itself. It is at present a purely horticultural garden.

Further details can be found in J. Royle in his 'Essay on the Productive Resources of India', London (1840) and in the Poona District Gazetteer, Vol. xviii, part 3, p. 128 (1885) under *Dapuri.*'

MAHARASHTRA ASSOCIATION FOR THE
CULTIVATION OF SCIENCE,
POONA.

S. P. AGHARKAR,
Ph.D., F.N.I.

33. GLEANINGS

A Fish Story

On page 113 of 'Arabian Days', H. St. J. Philby writes:—

'At Hakaika in Mesopotamia, we heard a good and presumably authentic fish story from the Garrison Commander. One of his soldiers had been fishing in the river with a lump of bread on an ordinary hook, when a mighty pull nearly dragged him into the water. He stuck to the rod, however, and the tackle held with some monster at the farther end. He got it ashore—a Euphrates salmon as long as a tall man and weighing 538 lb. All I can vouch for is that I saw a photograph of the man with his catch, and it was certainly a huge fish.'

In the *Journal*, Vol. xxvi, p. 679, under a letter dated October 12, 1918 is recorded a fish 69 in. long (measured along the curve of the back) and 38 in. in girth weighing 123 lb. and caught by Major H. L. Colan with atta.

Mr. Philby's notes are also made during the war years and we wonder if both these records refer to the same fish!

A Snake-killing Cat

M. R. Millet, French Embassy, Djakarta, Indonesia in a letter to the 'Field' (page 490, 17th September 1953) writes:—

'It is well-known in Siam that Siamese cats kill snakes and many people living there keep them for that reason. I have a two-year Siamese cat from Bangkok which has killed many snakes. He always bites them from the back of the head. He never eats them but often plays with them, but as far as I know he has never been bitten . . . . I never heard of a Siamese cat having died from a snake bite though I saw one with an enormously swollen head, the result of a bite from which he recovered.'

Direction-finding in Animals—Influence of Light and Heat

The many different ways in which animals find their way about were discussed by zoologists, Dr. H. W. Lissman of Cambridge University gave a general review of the problem of direction-finding in fish.

The two most spectacular examples are the breeding migrations of eels and salmon. No satisfactory explanation of these has yet been given although there is evidence that fish have a highly developed chemical sense and are sensitive to temperature changes of less than one-tenth of a degree.

As a more specialized type of perception he quoted his own recent discovery that certain African fish regularly emit electrical pulses and are sensitive to similar pulses either from other fish or their own if picked up and fed back again into the water. The case of the Sandhopper (*Talitrus saltator*) was described by Dr. D. I. Williamson, of the Marine Biological Station, Port Erin, Isle of Man.

Sandhoppers spend most of their time buried in the sand near high water mark but surprisingly they have been found to use different methods of navigation according as they were released on wet sand below high water mark or on dry sand above it. If released on wet sand they moved up-beach no matter whether the sun was shining or obscured, or whether the beach was one to which they were accustomed or not. Under laboratory conditions they responded to patterns of various shapes when projected on to a screen, and on the beach are thought to direct themselves by objects well above high water mark.

Seaward movements towards high water mark have been shown by Prof. L. Pardi and Dr. F. Papi in Italy to depend on sunlight and to be upset by moving the hoppers from one beach to another facing the opposite direction. Dr. J. L. Cloudsley-Thompson stated that the movement of centipedes, millipedes, and wood lice was governed during the day by their need to avoid dry, bright, and hot places. In the moist air at night their movements are less restricted and it is at night that they disperse themselves to new areas.

Dr. J. D. Carthy, of Queen Mary College, London, said that little was known of the stimuli which aided butterflies on their migratory flights, but more was known about the movements of locusts. Whereas it used to be thought that the long-distance movements of flying adult locusts were undertaken in the face of prevailing winds, it has been shown that these movements are often in the direction of local winds which may be contrary to the prevailing one.

The general direction of flight is thought to be canalized by physical features which the locust can see. So long as the wind is in the direction of flight, images pass over their eyes from front to back and flight is then continued. The reversal of this normal movement may cause the locust to settle.

—*The Times*, September 5, 1953

(Reproduced from *Science Newsletter* No. 123 dated September 11, 1953, item No. 1829).

Protection of Grain by Asphyxiation of Insect Pests

According to the report of the Food Manufacturers' Conference, workers in Argentine have discovered that when infested grain was stored in large underground pits, which had been leak-proofed for carbon-di-oxide, with roofing felt and bitumen, the perspiration of the insects caused a rapid rise in carbon-di-oxide concentration and corresponding fall in oxygen and the insects died by their own efforts.

Trial pits had been built and tested in parts of East Africa with promising results and it was likely that the method would be developed on a full commercial scale.

Another method by which the need for insecticide could be avoided, or at least minimised, was the self-sterilisation of bagged grain by stocking bags in the tropics as tightly as possible in order to conserve all the heat that might be engendered, much of the insect life in the centre of the stack was killed, or was driven to the periphery where contact insecticides could be used in the form of dusts applied to the outer bags. This method has been successfully used on a large scale in East Africa.

(Reproduced from *Science Newsletter* No. 126, October 2, 1953, item No. 1889).

NOTES AND NEWS

In the report for the period ending August 1953 (*Journ., B.N.H.S.*, Vol. 51, p. 979) we referred to the Bombay Wild Animals and Wild Birds Protection Act being brought into effect from 1st May, 1953. Though Government have advertised for a Wild Life Preservation Officer, no whole-time man has yet been appointed and the work is being looked after by Mr. J. A. Singh in addition to his other activities as Chief Conservator of Forests.

Upto 15th March, 1954, 1,150 Small Game (Rs. 20) and 138 Big Game (Rs. 60) Licences were issued. The number of offences detected under the Act throughout the State by the end of January was about 33 including 22 animals (12 panther, 7 tiger and 3 sambar) said to have been shot in defence of life and property.

Several instances of partridge and quail illegally trapped and sold were detected and a considerable number of these birds released at the Krishnagiri Park and in other places. Two persons have been fined Rs. 75 and Rs. 15 for shooting Cattle Egrets. The Honorary Game Wardens working in the neighbourhood of Bombay have been responsible for the above convictions and though shooting at night from cars and other illegal methods of shikar continue, this has been discouraged to a large extent in the city-dwellers and should soon cease completely.

The agriculturists who hold Crop-Protection Licences could, however, not be so easily contacted, and propaganda will have to be carried on a more extensive scale to impress the implications of the Act upon them.

With the appointment, however, of a full-time Wild Life Preservation Officer it is hoped that it will be possible to take the work more earnestly in hand, and that Bombay will be able to show to the other States the efficacy of its new Act.

CORRIGENDA

VOL. 51, NO. 4

In the articles 'Local and Scientific Names of Commercial Fishes of Bombay' and 'Occurrence of Brine Shrimp *Artemia* Sp. in Bombay'.

p. 924, line 8 from bottom: The words 'Estuarine Fish' appearing as a sub-heading, should be in bracketed parenthesis below '*Etroplus suratensis*'.

p. 951: In the caption to illustration of male and female *Artemia*,

'×22' in both places may be read as '×7'

'×200' may be read as '×67'

PRINTED AND PUBLISHED BY V. M. PHILIP AT THE DIOCESAN PRESS
18 CHURCH ROAD, VEPERY, MADRAS—1-7-1954. C905
EDITORS: SALIM ALI, AND H. SANTAPAU
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Vol. 52, Nos. 2 & 3

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CONTENTS OF VOLUME 52, NOS. 2 & 3

PAGE

WILD LIFE PRESERVATION IN INDIA: ANNUAL REPORT FOR 1953 ON THE EASTERN REGION. By E. P. Gee 233

COMMENTS ON THE BIOGEOGRAPHY OF ARABIA WITH PARTICULAR REFERENCE TO BIRDS. By S. Dillon Ripley. (*With two maps*) ... 241

OBSERVATIONS ON THE HABITS OF TWO SPIDER MIMICS OF THE RED ANT (*Oecophylla smaragdina* (FABR). By A. P. Mathew. (*With five text figures*) 249

WILD LIFE PRESERVATION AND SANCTUARIES IN THE UNION OF BURMA. By U Tun Yin. (*With a map*) 264

ABORIGINAL METHODS EMPLOYED IN KILLING & CAPTURING GAME. By K. M. Kirkpatrick. (*With six text-figures*) 285

A SUPPLEMENTARY NOTE ON THE STATUS OF RHINOCEROS AND THAMIN (*Panolia eldi thamin*) IN THE UNION OF BURMA, 1953. By U Tun Yin... 301

REPORT ON THE FORESTS OF THE NORTH TRIANGLE, KACHIN STATE, NORTH BURMA. By F. Kingdon-Ward 304

FOOD OF THE INDIAN GERBILLE *Tatera indica cuvieri* (WATERHOUSE) By M. R .N. Prasad. (*With one histogram*) 321

THE WHALE SHARK, *Rhineodon typus* (SMITH). By Charles McCann. (*With two plates*) 326

PETRELS, SHEARWATERS AND OTHER OCEANIC BIRDS IN THE NORTH INDIAN OCEAN. By W. W. A. Phillips 334

OBSERVATIONS ON *Tilapia mossambica* PETERS IN MADRAS. By P. I. Chacko and B. Krishnamurthi. (*With six text-figures*) 349

ON THE STRUCTURE AND POPULATION OF THE NEST OF THE COMMON INDIAN TREE ANT, *Crematogaster dohrni rogenhoferi* Mayr. (HYMENOPTERA, FORMICIDAE). By M. L. Roonwal. (*With one table, one text-figure and three plates*) 354

NOTES ON THE BUTTERFLIES OF THE NAGALAPURAM HILLS, EASTERN GHATS. By A. E. G. Best 365

THE BIRDS OF GUJARAT. By Sálim Ali. Part I (*With a map and five plates*)... 374

BIOLOGY AND ECOLOGY OF ORIENTAL TERMITES (ISOPTERA) No. 1—*Odontotermes parvidens* HOLMG. AND HOLMG. SEVERELY DAMAGING THE BARK AND CONTRIBUTING TO THE DEATH OF STANDING TEAK TREES IN UTTAR PRADESH, INDIA. By M. L. Roonwal. (*With two tables and a plate*) 459

PAGE

BIOLOGY AND ECOLOGY OF ORIENTAL TERMITES (ISOPTERA) No. 2—ON ECOLOGICAL ADJUSTMENT IN NATURE BETWEEN TWO SPECIES OF TERMITES, NAMELY *Coptotermes heimi* (WASMANN) AND *Odontermes redemanni* (WASMANN) IN MADHYA PRADESH, INDIA. By M. L. Roonwal. (*With one plate and one text-figure*) 463

NOTES ON LAND LEECHES. By J. L. Harrison 468

A SYNOPSIS OF THE GENUS *Ozobranchus* (DE QUATREFAGES 1852) (HIRUDINEA, ANNELIDA). By P. J. Sanjeeva Raj 473

A NEW SPECIES OF *Arthraxon* FROM PURANDHAR, BOMBAY STATE. By F. R. Bharucha and Y. Satyanarayan. (*With a plate*) 481

THE VEGETATION OF PILANI AND ITS NEIGHBOURHOOD. By T. S. Bakshi. (*With a map*) 484

POISONOUS SEEDS OF INDIA. By S. L. Nayar. Part II 515

THE GENUS *Cyathula* LOUR. IN INDIA. By T. S. Bakshi 533

ECOLOGY AND BEHAVIOUR OF THE SCORPION *Palamnaeus bengalensis* C. KOCH. By M. S. Kanungo. (*With two text-figures*) 536

CHECK-LIST OF THE TRIDACTYLIDAE AND GRYLLIDAE (INSECTA, ORTHOPTERA) OF CEYLON, WITH RECORDS OF DISTRIBUTION. By T. R. Sandrasagara 540

OBITUARIES :—

1. Sir Peter Clutterbuck 563
2. C. M. Inglis (*Photo*) 565

REVIEWS :—

1. Jungle Lore. By Jim Corbett. (M.R.S.C.) 569
2. The Snakes of India and Pakistan. By Lieut.-Col. K. G. Gharpurey, I.M.S. (J.C.D.) 569
3. A Field Guide to the Birds of Britain and Europe. By Roger Peterson Guy Mountfort and P. A. D. Hollom. (S.A.) 570
4. Poisonous Plants of India. By Sir Ram Nath Chopra, Rattan Lall Badhwar and Sudhamoy Ghosh. (H. Santapau, S.J.) ... 571
5. The Birds of Travancore and Cochin. By Sálim Ali (B. Biswas) 573

ADDITIONS TO THE SOCIETY'S LIBRARY 575

MISCELLANEOUS NOTES :—

1. Swimming and Locomotion of Captive Hedgehogs. By Iswar Prakash (p. 584). 2. Earthquake effect on Elephants. By Frank Nicholls (p. 585). 3. A Rorqual Whale near Badagar, Malabar Coast. By P. I. Chacko and M. J. Mathew (p. 585). 4. A Large Tiger. By T. B. Hawkins (p. 586). 5. Habits of the Asiatic Black Bear (*Selenarctos thibetanus thibetanus*) By U Tun Yin (p. 586). 6. Longevity of the Ceylon Ruddy Mongoose (*Herpestes smithi zeylanicus*) in Captivity. By W. W. A. Phillips (p. 587). 7. Record Sambar for the Nilgiris. By E. G. Phythian-Adams (p. 588). 8. Malformation in Antlers of the Malayan Sambar (*With a photo*). By H. J. Kitchener (p. 588). 9. Shikar in India. By K. M. Kirkpat-

rick (p. 589). 10. Intelligence of the Indian Elephant. By K. Kadambi (p. 590). 11. The Abominable Snowman (*With a photo*). By Editors. (p. 594). 12. The Occurrence of the Crested Bunting (*Melophus lathami*) in Saurashtra. By Y. S. Shivrajkumar (p. 598). 13. An Intelligent Myna. By (Mrs.) Syamala Murthy (p. 598). 14. Bayas and Fireflies. By P. G. S. Hall (p. 599). 15. More Notes on Finn's Baya (*Ploceus megarhynchus*). By Humayun Abdulali (p. 599). 16. Sparrows nesting in colonies in Trees. By Humayun Abdulali (p. 601). 17. A display of the Redwinged Bush-Lark (*Mirafra erythroptera* Blyth). By K. M. Kirkpatrick (p. 601). 18. The Courtship Display of the Large Pied Wagtail (*Motacilla maderaspatensis* Gmelin). By K. M. Kirkpatrick (p. 602). 19. The Occurrence of Franklin's Nightjar (*Caprimulgus monticolus monticolus*) in Travancore-Cochin. By M. C. A. Jackson (p. 603). 20. Occurrence of Spurs in the female Jungle-fowl (*Gallus sonnerati*). By Editors (p. 603). 21. The Great Indian Bustard. By Editors (p. 604). 22. Occurrence of the Blacknecked Crane (*Grus nigricollis*) in Indian limits. By F. N. Betts (p. 605). 23. The Status of the Pheasant-tailed Jaçana (*Hydrophasianus chirurgus*) in South India. By C. H. Biddulph (p. 606). 24. Occurrence of Bronzecapped or Falcated Teal (*Eunetta falcata*) near Calcutta. By J. N. Taylor (p. 607). 25. Birds associating Natural Phenomena with Food Supply. By Charles McCann (p. 607). 26. Some Bird Notes from Chingleput District, Madras. By Rev. E. O. Shaw (p. 609). 27. Birds seen above the tree-line in Tehri Garhwal in the Central Himalayas (*With two plates*). By H. F. Lamprey (p. 610). 28. The Secondary Song of Birds. By K. K. Neelakantan (p. 615). 29. Pythons. By Frank Nicholls (p. 620). 30. Notes on the Frog *Rana breviceps* Schneider (*With a sketch*). By J. L. Bhaduri and M.B. Kirpalani (p. 620). 31. A Record of the Whale Shark (*Rhineodon typus* Smith) from the Malabar Coast. By P. I. Chacko and M. J. Mathew (p. 623). 32. Food Organisms of *Gadusia chapra* (Ham.) from certain Ponds with thick *Euglena* blooms. By P. Mohapatra (p. 624). 33. The Relationships of Total Length to Furcal Length for five Cyprinids (*With five graphs*). By P. Mohapatra (p. 626). 34. Effect of Jaggery on Fish Life. By P. I. Chacko and R. Srinivasan (p. 629). 35. Spawning of Rohu at Powai Lake. By F. R. Goldschmidt (p. 634). 36. Distribution of *Rana leithii* Bouleng. A Correction. By Humayun Abdulali and J. C. Daniel (p. 635). 37. Extension of range of *Rana temporalis* Gunth. By Humayun Abdulali (p. 636). 38. Extension of range of the Frog *Uperodon globulosum* Gunth. By Humayun Abdulali and J. C. Daniel (p. 637). 39. Food of the Bull-Frog (*Rana tigirina*). By (Mrs.) Aruna Banerji (p. 639). 40. Distribution and Habits of the Batrachian, *Ichthyophis glutinosus* Linn. By Humayun Abdulali (p. 639). 41. A Note on the Courtship in the Sand Crab (*Philyra scabriuscula* (Fabricius). By (Miss) K. G. Raja Bai Naidu (p. 640). 42. Sex Ratio and Variability of Apodous Segments in *Apus* (Phyllopoda, Crustacea). By Krishna Kant Tiwari (p. 641). 43. Occurrence of the mantis *Gongylus gongyloides* Linn. in Junagadh (Saurashtra). By I. H. Kachhi (p. 644). 44. On Some Unrecorded Host Plants of the Lac Insect, *Laccifer lacca* (Kerr) (Homoptera, Lacciferidae). By A. P. Kapur (p. 645). 45. Presumptive Fatal Sting of the Common House Wasp, *Polistes hebraeus*. By J. N. Onial (p. 647). 46. Some Insects Attracted to Light. By S. Usman (p. 647). 47. Land Leeches. By R. N. Champion-Jones (p. 650). 48. Land Leeches. By F. M. Bailey (p. 652). 49. Land Leeches. By J. L. H. Williams (p. 652). 50. Land Leeches. By R. S. Mathews (p. 655). 51. 'Nwe-Shin' or 'Live

PAGE

Creeper'. By H. G. Hundley (p. 656). 52. Identity and Taxonomical Status of *Sesamum ekambaramii* Naidu. By S. Ramanujam and A. B. Joshi (p. 657). 53. The Genus *Murdannia* in Bombay State. By H. Santapau (p. 658). 54. The Genus *Murdannia* in Bombay—Further Corrections. By H. Santapau (p. 658). 55. Some Recently Introduced or Newly Recorded Plants from Patna District and its neighbourhood. By J. G. Srivastava (p. 659). 56. A note on *Ventilago gamblei* Merrill. By M. B. Raizada (p. 660). 57. New Plant records for Bombay (*With two plates*). By R. Fernandes, A. Randeria and H. Santapau (p. 661). 58. E. J. Woodhouse—His Contribution to Our Knowledge of the Flora of Bihar. J. G. Srivastava (p. 663). 59. Gleanings (p. 665).

NOTES AND NEWS 668

ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR ENDING 31ST DECEMBER 1953 669

THE HONORARY SECRETARIES' REPORT FOR THE YEAR 1953 670

APPENDIX TO THE HONORARY SECRETARIES' REPORT COVERING THE PERIOD JANUARY TO AUGUST 1954 677

STATEMENT OF ACCOUNTS OF THE BOMBAY NATURAL HISTORY SOCIETY ... 679

MINUTES OF THE ANNUAL GENERAL MEETING 684

JOURNAL
OF THE
BOMBAY NATURAL HISTORY SOCIETY

1954 VOL. 52 NOS. 2 & 3

WILD LIFE PRESERVATION IN INDIA:
ANNUAL REPORT FOR 1953 ON THE EASTERN REGION

BY

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CONTENTS

PAGE
I. THE EASTERN REGION 233
II. WILD LIFE IN THE REGION 234
III. STATE WILD LIFE BOARDS 235
IV. WILD LIFE RESERVES, SANCTUARIES, AND NATIONAL PARKS 236
V. WILD LIFE LEGISLATION 237
VI. GENERAL 239

I. THE EASTERN REGION

During the year 1953 the Eastern Region under the Indian Board for Wild Life comprised the following States: Assam, Bengal, Bihar, Manipur, Orissa and Tripura.

The North East Frontier Agency, an area containing rich and varied wild life and some of the finest mountain and river scenery in India, is not included in this Region. It is to be hoped that in the near future the N.E.F.A. will be in a position either to form its own Wild Life Board or to send representatives to the Assam Wild Life Board and thus become co-ordinated with Assam in the matter of wild life preservation.

Similarly, Bhutan is adjacent to Bengal and Assam and has mutual problems concerning wild life preservation; and it would be in the interests both of India and Bhutan if the latter country could be closely associated with India in this respect. The same kind of problems exist on the borders of Bihar and Nepal, and it would also be in the interests of both these States if concerted action could be taken to preserve wild life.

II. Wild Life in the Region

Rhinoceros. Perhaps the most valuable animal in the Region is the Great Indian One-horned Rhinoceros, and its numbers may now be estimated as follows: Assam 347, Bengal 43, Bihar 2 (and Nepal 48). There are signs of a revival of interest in the Jaldapara Sanctuary of Bengal, and this factor should enable the depleted rhino population of that area to be increased to what it was some twenty years ago. Officially I believe there are no rhino in Bihar, but it is reported that occasionally a few of the fifty or so animals of Nepal wander across the border into India. It might be possible to create a sanctuary in the Champaran District of Bihar in order to provide a refuge for these stragglers from Nepal; and this sanctuary might in later years develop into a safe stronghold of this most important creature.

Elephant. It is fortunate that the wild elephant appears to be able to hold its own in spite of the advance of civilisation into its habitat. Although its numbers are being constantly reduced by capturing and controlled shooting wherever damage to crops is reported, its prolific nature leads us to feel assured of its continuance in the future.

Gaur ('Bison' or 'Mithan'). This fine animal is becoming much rarer in north-east India, chiefly owing to its susceptibility to diseases spread by domestic cattle and buffaloes. It is recommended that it be protected as much as possible.

Buffalo. In spite of rinderpest this animal continues to survive in safe numbers in Assam and north Bengal, and in some parts of Orissa. The sad news has been received from the Chief Conservator of Forests, Bihar that 'the wild buffalo of Purnea also probably has vanished with the privately-owned forests were its last refuge and were cut down'. It is essential that domestic cattle and domestic buffaloes of graziers and villagers adjacent to wild buffalo sanctuaries should be compulsorily innoculated against rinderpest. Some research is needed into the question of the advantages or otherwise of the crossing of tame buffaloes with wild ones, as there are conflicting accounts of the quantity of the milk supply and of the quality of the offspring after such crossings have taken place.

Swamp Deer. Unlike the sambar which frequents thick forest and hilly regions, the swamp deer confidingly inhabits the more open places and presents an easy target to poachers and others. Because of its meat value as compared with the hog deer, the swamp deer has become exceedingly rare in the States of this Region and requires the most rigid protection—especially in sanctuaries.

Serow and Goral. These goat-antelopes are also in need of protection. (Takin and Musk Deer exist in the mountainous areas of the N.E.F.A. and Bhutan, and are therefore outside the scope of this report.)

Thamin or Brow-antlered Deer. In spite of enquiries and search by the Forest Department in Manipur, no trace can now be found of this beautiful deer which once existed in fair numbers in that State[1]. This is most unfortunate and a great loss to the wild life of India. Owing to its habit of wandering from place to place in search of grazing etc., the prospect of re-introducing it from Burma is not feasible. Moreover the Burma Brow-antlered Deer is a different sub-species.

Pygmy Hog. This peculiar diminutive pig seems to have disappeared from the foothills of Bhutan, though it used to be found a few decades ago in the forests of Assam (and Bengal) adjoining Bhutan.

Clouded Leopard. The progressive reduction in the numbers of the carnivora is the natural result of the gradual decrease in the populations of deer and such other animals, but the rarity of the clouded leopard led the Mysore Conference of the Indian Board for Wild Life to recommend this beautiful animal for full protection. It is to be hoped that its preference for thick forest will prevent its becoming extinct.

Florican. Owing to the clearance for cultivation and the opening up by grazing of large tracts of grassland, the Bengal Florican has become rare in recent years. A number still exist in Kaziranga Wild Life Sanctuary in Assam, and it is to be hoped that this bird can be saved from extinction in all the States of this Region.

Pinkheaded Duck. Reports of this duck having been seen or shot in recent years are open to doubt owing to the fact that many people confuse the Pinkheaded Duck with the Redcrested Pochard. It is a regrettable fact that there is no really authentic evidence of the Pinkheaded Duck having been seen in the last few years.

White-winged Wood Duck. This duck still exists in Assam, at any rate. As it can be kept in captivity fairly easily, the possibility of rearing it in zoological parks or private gardens should not be ignored.

Monitor Lizard and Python. These two reptiles are protected in some States of the Region, but unfortunately the trade in their skins goes on unchecked. Information obtained at the receiving end in this trade (e.g. Calcutta) reveals that many persons out in the mofussil are collecting these skins, and the matter needs careful investigation.

III. STATE WILD LIFE BOARDS

1. Assam. The Assam Wild Life Board was constituted on 8th June, 1953, and consists of 10 members comprising 4 officials and 6 non-officials, with the Minister for Forests as Chairman and the Senior Conservator of Forests as Secretary and Convenor.

The first meeting of this Board was held on 9th and 10th September, 1953, in Shillong.

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[1] Since reported to be surviving in small numbers in Manipur.—EDS.

A great number of items was dealt with, and two sub-committees were formed, one for framing rules etc. for the Board, and one for revising the Assam Forest Regulations in so far as they deal with the protection of wild life and for drafting a simplified version of the Arms Act as applicable to Assam.

2. Bengal. No Wild Life Board as such exists in Bengal, and the Conservator-General of Forests has informed me that it is not considered necessary to create a Wild Life Board as there already exists the Forest Advisory Board. To what extent this Forest Advisory Board will be able to deal fully and efficiently with all the problems of wild life preservation I am not at present in a position to say. Possibly the appointment of a few additional members to represent wild life and sporting interests might solve the problem, or perhaps a technical sub-committee to deal with wild life matters might be preferable.

3. Bihar. The Bihar Wild Life Board was constituted on 3rd December, 1953, and consists of 11 members comprising 5 officials and 6 non-officials, with the Minister for Forests as Chairman and the Chief Conservator of Forests as Secretary and Convenor.

4. Manipur. The Manipur Wild Life Board was constituted during the year, with the Deputy Commissioner as Chairman and the Forest Officer as Secretary, with four other members.

The first meeting of the Board was held on 21st October 1953 at Imphal. Among the many items dealt with was the complete closing of shooting in the Logtak area, which has been made into a sanctuary.

5. Orissa. Information has been received from the Director of Forests, Orissa, that the State is trying to constitute a State Wild Life Board.

6. Tripura. So far no information has been received concerning the constitution of a State Wild Life Board.

IV. WILD LIFE RESERVES, SANCTUARIES AND NATIONAL PARKS

1. Assam. Steps are being taken to up-grade the Laokhowa and Orang Reserves into Sanctuaries, and the Kaziranga and North Kamrup (Manas) Wild Life Sanctuaries are to be constituted as National Parks under the Assam National Parks Bill now in draft form. It would be to the advantage of Assam as well as of Bhutan if the latter State could create a sanctuary or national park on its side of the boundary north of and adjacent to the North Kamrup Sanctuary of Assam, and a proposal has been sent to Bhutan concerning this.

2. Bengal. The Conservator-General of Forests has informed me that they are putting up a proposal to the Government for the management of the Jaldapara Sanctuary as a national park.

3. Bihar. At present there are only four sanctuaries in the State, totalling just over 250 sq. miles. The Chief Conservator

of Forests has informed me that the creation of a national park is contemplated, or alternatively a large sanctuary covering about 200-300 sq. miles in extent.

A very noteworthy fact which should be mentioned here is that the Forest Adviser of the Soil Conservation Department of the Damodar Valley Corporation has drawn up a detailed proposal for a national park or wild life sanctuary in the D.V.C. Area, which is to be forwarded to the Bihar Government for their approval. The area selected is one of 320 sq. miles of Sal forest 13 miles from Hazaribagh. The opportunities offered by the changing of the countryside by these multi-purpose river projects should be quickly grasped by nature conservationists, as here are good chances of effecting some sound wild life preservation and even of restoring species which have become extinct in recent decades.

4. Manipur. The Logtak Lake area has been made into a sanctuary, and shooting closed there throughout the year. While commending the authorities of Manipur for their good intentions in creating a sanctuary for the preservation of wild life, I personally, as well as many other naturalists, doubt the wisdom of choosing the Logtak Lake area for this purpose. Now that the Brow-antlered Deer has disappeared, the chief wild life of this area is the wildfowl which frequent the lake. But these are mainly migratory, and in plentiful numbers; and I feel that some other place, perhaps in the hills where wild life is being exterminated by shifting cultivation and other evils, could have been more wisely selected. Moreover, the Logtak Lake used always to be a favourite shooting ground for *bona fide* sportsmen visitors to the State, and their absence will be regretted in more ways than one.

5. Orissa. I have no information as to existing or proposed sanctuaries in Orissa.

6. Tripura. The Forest Officer of this State has informed me that the opening of a wild life sanctuary is under the active consideration of the authorities.

V. WILD LIFE LEGISLATION

1. The effectiveness of Existing Legislation.

This item need not be dealt with State by State, for the same story is heard in all the States of this Region, as in other Regions. It is not so much the lack of effectiveness as the lack of enforcement of the existing legislation. As became apparent at the Mysore Conference, the machinery for preserving wild life exists all over India but has become neglected and in some cases fallen into disuse.

There are two alternatives now: one is to revive the old legislation and strictly enforce it, and the other is to make new and up-to-date legislation. I am in favour of the latter course, provided it is not too elaborate or difficult to enforce. I consider the Bombay Act of 1951 an excellent piece of legislation for the preservation of wild life, but can it be enforced? According to this Bombay Act, if a man shoots a bulbul, say, in his own vegetable garden he is liable to prosecution. There is no chance of such intricate legislation being properly enforced.

I feel that a simplified and up-to-date form of the Wild Birds and Animals Protection Act of 1912 might be the answer. A rationalised and simplified schedule of close seasons and protected animals and birds, easy of enforcement, is desirable.

I also recommend that first things be done first; that is pay full attention to the sanctuaries first and make them proof against poaching and properly guarded; then pay attention to the reserved forests and make them proof against poaching and all illicit practices; and then after these two items have been fully dealt with turn attention to the unclassed forests, waste lands, private lands, and so on.

Under the present state of legislation, detection of offenders is difficult and charges hard to substantiate. And when a case is successfully brought and proved, the magistrate imposes an absurdly lenient fine—Rs. 60, say, for a hog deer killed and valued at Rs. 120 for its meat, or even for a sambar valued at Rs. 400. These fines were probably fixed some 50 years ago, and since then the value of money has changed, but not the fines.

The Forest Department, which has control of all sanctuaries and reserved forests, can 'compound' a case for up to Rs. 50 only. This 'fine' was also fixed some 50 years ago, and by the present value of money should be raised to Rs. 200. If a Divisional Forest Officer could compound cases of offence against the Forest Regulations with a fine of Rs. 200 and also possibly with a liability of the offender to pay the amount of damage done (as is sometimes done in Bengal—a good idea), the immediate protection given to wild life would be very great indeed. In fact I feel certain that the first step in any proposed legislation of any kind should be the revision and improvement of the State's Forest Regulations in so far as they apply to wild life preservation.

Holders of 'crop protection' guns are well-known as responsible for extermination of much wild life. Since the handing in of these guns after the crops have been reaped presents a great administrative problem, it would perhaps be a better idea if the use of these guns is restricted to the area of crop-producing land actually belonging to the possessor of the gun, and if he wishes to shoot elsewhere he must obtain an extra licence. Licence fees for possession of guns and for shooting with them should be increased—these again are in many cases the same as they were 50 years ago when the value of money was much greater than now.

2. New Legislation Passed or Contemplated.

(1) Assam. The draft Assam Rhinoceros Preservation Bill was scrutinised by the Assam Wild Life Board, and modified in places where considered necessary. An Assam National Parks Bill has been drafted and will soon be placed before the Wild Life Board for approval. Sub-committees have made proposals for the Rules etc., of the State Wild Life Board, and for the revision of the Assam Forest Regulation.

(2) Bengal. Proposals are being put up to Government for the management of the Jaldapara Sanctuary as a national park. The Conservator-General of Forests is of the opinion that Forest Officers should be invested with the powers of a police officer to demand the production of a licence and of a gun for examination. The Government has renewed the leases to the Associations of the Game Federation of Bengal.

(3) Bihar. Measures contemplated are: Rationalisation of the 'Close' season for all kinds of birds and animals; the enactment of a special law applicable only to the State-owned Forests which will provide for deterrent penalties, including confiscation of fire-arms and cancellation of licences of habitual offenders, and the creation of a national park, or in the alternative of a large sanctuary covering about 200-300 sq. miles in area.

(4) Manipur. Certain Rules have been framed in accordance with the Indian Forest Act to effectuate proper control and preservation of wild life.

(5) Orissa. No information has been received up-to-date of any legislation either passed or contemplated.

(6) Tripura. Measures contemplated are: creation of a wild life sanctuary, and rules for shooting.

VI. GENERAL

It is generally agreed, particularly in the Eastern Region of India, that a separate wild life organisation is not feasible, and that wild life preservation is best taken care of by the Forest Department under whose charge most of the wild life already falls.

To counteract the possibility that the Minister for Forests and the officials of the Forest Department may not always act in a way best calculated to serve the interests of wild life, it has been accepted that each State should have a Wild Life Board whose main function will be to advise the Forest Department on all matters affecting wild life. Obviously these Boards must contain a strong, influential and knowledgeable element of non-officials, who should fully represent all important sections of public opinion and should contain among their number some experts in the field of nature conservation, natural history and sport.

In order that the Forest Department, advised by the Wild Life Board, may efficiently carry out its duties, it is essential that the Forest Regulations should be revised and brought up-to-date.

The State Forest Department can do a very great deal by strong executive action in the way of Gazette Notifications. For example, in Assam there used to be shooting of sanctuary animals all round the Kaziranga Sanctuary, just outside the boundaries. But a Gazette Notification issued on April 6th, 1953, declared a buffer zone all round Kaziranga Sanctuary with specified limits, within which shooting is prohibited the whole year. The result has been very encouraging, and poaching round the fringes of the sanctuary has almost entirely disappeared.

A great deal of shooting by artificial light at night from machans over salt-licks and from vehicles takes place, and indiscriminate poisoning and dynamiting of fish in rivers. This is often connived at, if not actually done by subordinate officers of all the Services. In addition to warnings of severe penalties to be imposed, I think some publicity needs to be done to instill into these subordinate officers the best traditions of sportsmanship and sport of all kinds. For example, if military officers were interested in the sport of fishing with rod and line, they would not connive at their men dynamiting rivers for fish.

Information on the wild life of the States of the Region is urgently required, and it is recommended that the series 'Wild Life Reserves in India' as published by the Bombay Natural History Society (Bihar by Jamal Ara in Vol. 48, No. 2, pages 282-287 and Assam by E. P. Gee in Vol. 49, No. 1, pages 81-88) be continued and include the other States of the Region and of the Indian Union as a whole.

It is a welcome sign that in all the States of this Region there is a growing realization that much publicity for wild life preservation needs to be done in the Press, Radio and in Education. It is well-known that the best way of educating the adults is through their children. What is urgently wanted are suitable text-books, one for each stage of school and college curriculum, illustrated and well produced, to stress the need for nature conservation, preservation of wild vegetable and animal life and all allied subjects. In matters of wild life preservation conversion is easier than coercion, and once the children have been shown the value of wild life, the enforcement of legislation will become very much less difficult.

February 15, 1954.

COMMENTS ON THE BIOGEOGRAPHY OF ARABIA WITH PARTICULAR REFERENCE TO BIRDS

BY

S. Dillon Ripley

(With two maps)

During World War II my interest became aroused in southern Arabia, when I had occasion to fly over it several times on military business and to land at various hitherto inaccessible places, such as Sharjah and Dhahran. Although the mountains of Yemen in the south-west have been visited by naturalists, notably a British Museum of Natural History expedition in 1937 (Scott, 1942), virtually nothing is known of the fauna of Muscat and Oman, and of the spectacular so-called 'Green' Mountains, the Jabal al Akhdhar, which rise to a height of over 10,000 ft.

In 1950 I had an opportunity to visit Arabia and Muscat, but was prevented by a changed schedule from actually visiting the south-eastern corner of the Peninsula. However, as a result of that visit and of my correspondence with the Sultan of Muscat, three years later a joint collecting expedition, sponsored by the Philadelphia Academy of Natural Sciences and Yale's Peabody Museum (de Schauensee and Ripley, 1953) was arranged. The collection made on this expedition has added considerably to our knowledge of the avifauna of the area, and has prompted me to prepare the following comments.

Little can be understood of the history of the fauna of Arabia without an attempt to picture the geological events which have produced the conditions perceived today. The following brief summary of the recent geology of Arabia, therefore, seems appropriate.

Geology

The Peninsula of Arabia is a vast peneplain, bordered at its western, south-western, and south-eastern extremities by two blocks of highlands composed of a core of ancient crystalline rocks on which have been superimposed huge thicknesses of successive formations, mainly sandstones, during the Cretaceous.

In late Cretaceous or early Cenozoic time, western Arabia was uplifted far above sea level and a period of faulting and crustal movements set in. At this time western Arabia was connected to Africa, which, during a large part of this period, was isolated from the rest of the world. This unity remained until early Miocene time. Vulcanism developed and has continued to the present as evidenced by hot springs and vapor fissures. There are many lava outcroppings in the western Arabian highlands. The tableland of Yemen is an enormous upraised block of lower Cenozoic or Tertiary age with central peaks rising to 10,000 ft. above sea level.

Eastern Arabia was submerged in Miocene time, emerging before the end of this period, covered with Eocene sediments. According to Gregory (1929) the Oman Mountains are related to the Zagros mountain system. He feels there is no evidence for considerable submergence in south-western Iran, or a broad separation between Eurasia and Arabia by intervening seas. On the contrary there seems to be no certain evidence for a land connection during this period across the Persian Gulf. Certainly the northern part of the Gulf is post-Pliocene (*vide* Gregory, 1929: 118).

Meanwhile before the end of the Miocene, the time of the worldwide spread of savannah vegetation types still characteristic of parts of eastern Africa, the Red Sea was flooded from the north by the Mediterranean, but Arabia remained connected to Africa through Yemen-Somaliland (Furon, 1941). This latter connection was broken in late Pliocene and meanwhile a Sinai connection had arisen which has continued in roughly the same shape to the present day era of the Suez Canal.

The above brief summary of geological events prior to the Pleistocene is given to indicate only that there had been land connections between Arabia and the adjacent continents as far back as the origin of the Peninsula, but that these connections were not always contemporaneous, and that the mountains of the south-western parts of Arabia in Yemen and of the south-eastern in Oman respectively, are neither contemporary nor apparently closely related.

PLEISTOCENE

Superimposed on these earlier rocks are alluvial and aeolian deposits of Pleistocene date. The Pleistocene is noted, of course, for its glaciation in the temperate zones of the world, as well as for a certain amount of transitory glaciation in the higher montane equatorial areas. Flint (1947: 468) describes conditions in the northern hemisphere which tended to produce the so-called pluvial periods in the tropical latitudes:

> 'With the gradual growth of ice sheets in North America, Siberia, and Europe and with the growth of sea ice in the Arctic Sea and the North Atlantic, high-pressure conditions were established in the air over them, and the entire belt of eastward-moving cyclonic storms ('the belt of westerlies') was shifted progressively southward. In South America a similar northward shift took place, but it was certainly less pronounced because the area of glacier ice in southern South America was comparatively small.
>
> 'As the belt of cyclonic storms edged southward, regions—especially in the extra-tropical belts of high pressure—that are dry under the climates of today began to experience increased rainfall. At the same time the increased cloudiness that characterizes the belt of westerlies operated to reduce the evaporation rate, already diminished somewhat by the worldwide cooling that had preceded the growth of the ice sheets. The results were increased stream discharge, expansion of existing lakes without outlets, and the

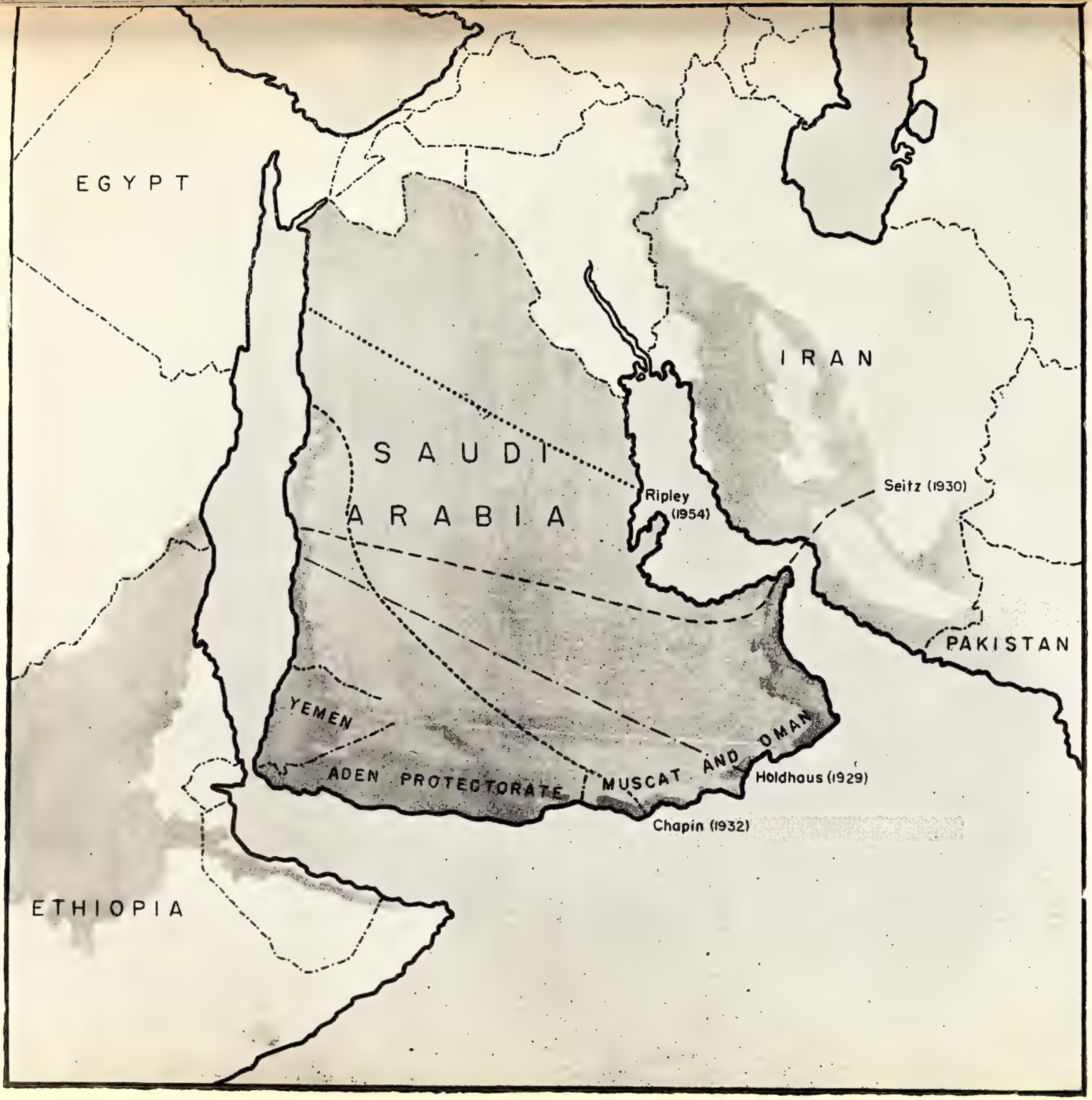
EGYPT
IRAN
SAUDI ARABIA
Ripley (1954)
Seitz (1930)
PAKISTAN
YEMEN
ADEN PROTECTORATE
MUSCAT AND OMAN
Holdhaus (1929)
Chapin (1932)
ETHIOPIA

Figure 1. Map of Arabia showing highlands (shaded areas), and proposed lines of demarcation between the Palaearctic Zone, and the more southern types or districts, as proposed by various authors, cited in the text.

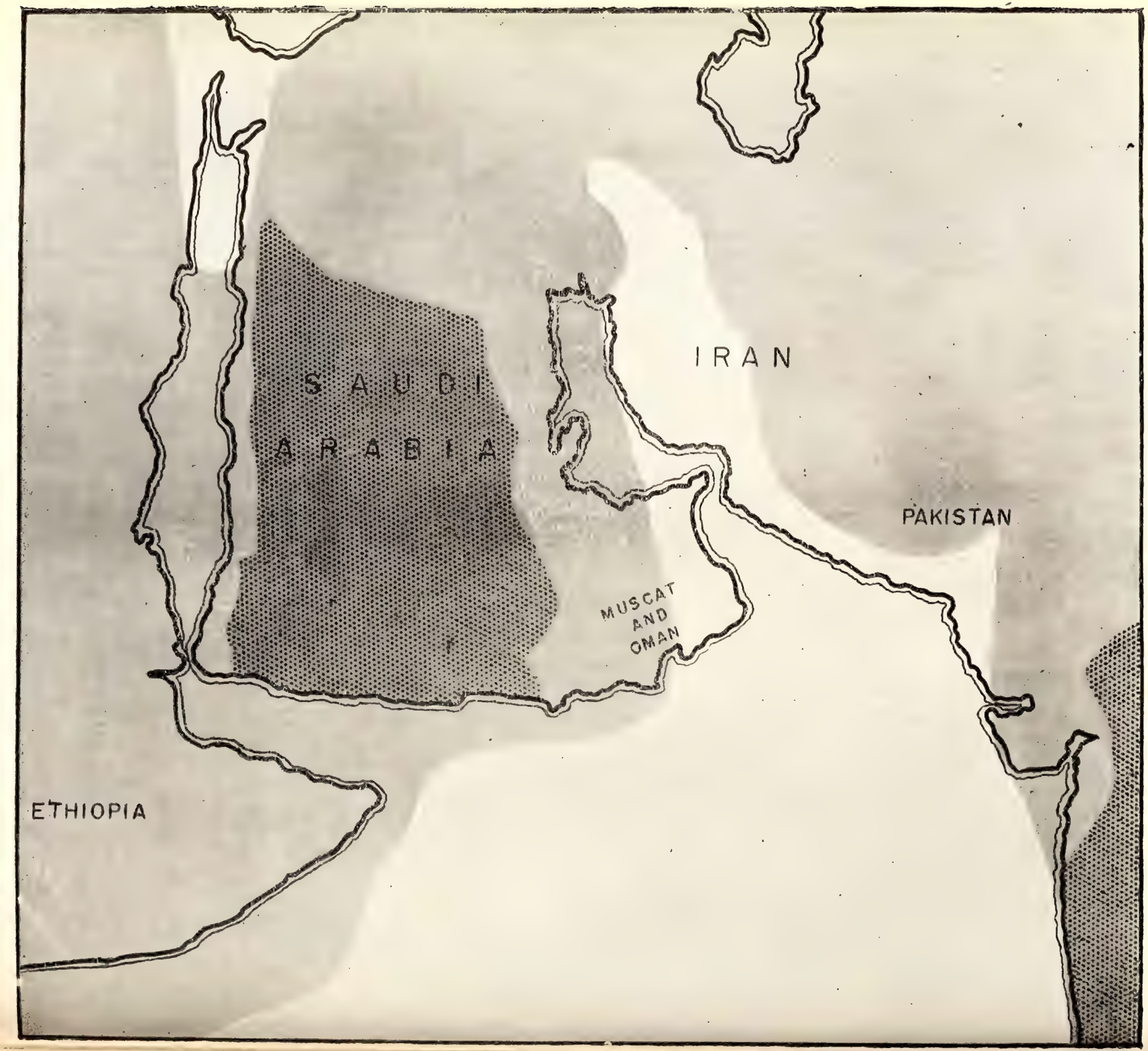
SAUDI
ARABIA
IRAN
PAKISTAN
MUSCAT
AND
OMAN
ETHIOPIA

Figure 2. Arabia as it might have appeared in early Miocene time, (adapted from Gregory). Shaded area represents dry land, the stippled areas, 'Arabian Upland Basin', and 'Gondwana' respectively.

> creation of lakes in basins previously dry. In short, a pluvial age came into being.
>
> 'In the Old World, in like manner, pluvial conditions affected chiefly the Mediterranean lands, northern and central Africa, Asia Minor, central Asia and northern China. However, the effects were felt right down to the equator itself, where evidence of expanded lakes in East Africa is clear and extensive. This fact is not as surprising as it seems at first. The northern half of Africa is the only large subtropical land mass lying north of the equator. Because of this vast expanse of land it is more favourably situated than any other subtropical region to receive winter-season outbreaks of cold polar air. Even today these outbreaks reach as far south as latitude 15°. During the glacial epoch these outbreaks should have reached the equator itself.'

During these pluvial periods it has been assumed that the average temperatures fell several degrees [how much for the equatorial belt is uncertain and equivocal (Moreau, 1933, 1952)], but at 20°N. latitude there is little doubt that it would be a significant figure. Even a relatively small change in temperature plus increased precipitation would be enough to alter the climate sufficiently to extend the savannah and arid vegetation types north along the western Arabian coast to Sinai and Egypt, and on the east from Trucial Oman to Iran, thus making a continuous belt of light forest and grassland in the form of a connecting link between Arabia and the continents.

Huzayyin (1941) who has worked in Yemen reports evidences of two major pluvial periods which he equates with the Kamasian and Gamblian in East Africa, with an interpluvial stage characterized by vulcanism as also found in Africa. Zeuner (1950) states that both these pluvials are contemporary with a Levalloisian variety of the Paleolithic. Other remains of prehistoric man are still rare in the literature for Arabia. Blades, burins, and end scrapers of Levalloisio-Mousterian type have been found at Turaif near the Jordan border, and Mousterian implements at Badanah near Iraq, both of the last interglacial or the beginning of the last glacial period in date (Coon, personal communication).

Caton-Thompson and Gardner (1939) report paleoliths of a crude Levalloisian type from the Hadhramaut indicating in their opinion a low ebb in paleolithic culture, perhaps due to the impoverished and harsh environment, also indicating a degree of isolation from the nearby cultures of Africa, North Arabia, and Palestine. Such evidence as there is, then, would indicate that pluvial conditions during the Pleistocene were enough only to ameliorate, not to change radically, the rather arid biota of Arabia. Savannah grassland and thorn scrub could have existed over large parts of the Peninsula, especially outlining the shore lines and montane features, where only desert exists today. That in itself would have been sufficient to encourage the spread of animals, plants, and associated man.

PLEISTOCENE—RECENT

There are some scraps of evidence for a more recent wet phase. Huzayyin (1941) proposes that this wet phase may have continued as late as 1600 years ago, basing his theory largely on archaeological data. Philby (1933) found gravel spread on the north side of the Rub-al-Khali (possibly lacustrine) and stone artifacts of neolithic facies. This might be correlated with the 'Neolithic' wet phase found in Egypt at Fayoum and Kharga, and 'Pluvial C' in Palestine. In the Sudan Red Sea Hills there is some evidence for a wet phase about 10,000 to 15,000 years ago based on the semi-fossil Mollusca found there. Many other evidences point to the existence of a so-called Mesolithic rainy interlude (Murray, 1951) in Egypt, Libya, and the Sudan, dating as late as 4000 B.C. and extending back at least to 8000 B.C. This date would be satisfactory when compared with the recent radiocarbon datings of about 10,000 years ago for the Mankato maximum of Wisconsin, preceded by a warmer period about 11,400 years ago (Allerod horizon-Two Creeks) in Western Europe and North America (Flint and Deevey, 1951, Flint, 1953).

Dessication certainly began in Africa about 6,000 years ago and has continued to the present with little change. In Nubia there has been no continuous rainfall since about 5,500 years ago. Wood-Jones (1907-1908) reported the preservation of later predynastic bodies of that time, which were buried in the sand, as so complete that even eyes and brains are preserved, shrunken but intact. Gradually the scrub forests and the grasslands have disappeared. Stumps of trees lie on the Libyan desert where they have not grown for 5,000 years. Similar vestiges occur near Taif in western Arabia. Networks of trails of grazing animals cover hillsides where the vegetation disappeared in early predynastic times. Flake industries existed on hills in eastern Egypt which have not supported populations for millenia. The rise of the climatic optimum or thermal maximum in Europe which has been dated from about 6,000 to 3,000 years ago (Flint and Deevey, 1951) sounded the knell of the sparse savannah and steppeland growth of the lowlands of Arabia which thereby began their long progress towards the desert conditions of today. In spite of these minor changes, there is no indication whatsoever that the climate of this part of the world has undergone any radical alterations since the commencement of the Pleistocene.

CLIMATE TODAY

Today rainfall in Arabia as a whole is insignificant. In the Yemen highlands it may reach 14 to 15 inches annually, mostly during the summer monsoon. In these highlands there are perennial streams and springs, although no streams reach the coast or far into the interior, losing themselves in their older, greater courses in the sand.

In the adjacent lowlands rainfall is no more than 2½ inches per annum, with interior areas of the Peninsula having less. Isolated from the south-western hills (although the southern coastal belt of the Dhofar receives moisture in the form of a cloud and mist cover and heavy dews from the sea) are the south-western Oman hills. Rainfall may reach 4 inches in the coastal area, concentrated during December and January. Figures are not available for the Green Mountains of Muscat which have a parallel rainy season, and an intermittent cloud cover as well with a mist blanket of moisture in lieu of rain. In

February each year, crop of fine grasses springs up on the plateaux at 6,000 ft. which is grazed by feral asses. There are no perennial streams in Oman.

The principal vegetation of Arabia is xerophytic, the habitats ranging from open desert sand to rocky cliffs, to arid steppe highlands dotted with occasional grasses or shrubs, many of them succulent, to patches of tropical grassland savannah. On the heights cultivation occurs with olives, figs, citrus trees, grains, wheat, barley, 'dhurra' or sorghum, millet, lucerne, and coffee above 5,000 feet. These isolated highlands in the south-west and south-east serve as 'islands,' 'refugia,' for relict, Palearctic plants—primulas, iris, potentillas, and such genera as *Juniperus*, *Monotheca*, and *Caylusea*.

Among birds there are important Palearctic relict forms in Yemen such as the Hedge-Sparrow, the Bullfinch, the Wheatear, Gray Shrike, and the Serin Finch. There are Palearctic relict reptiles and numerous insects, all presumably dating from pluvial times. Among the mammals, however, none can be ascribed to the Palearctic with the possible exception of the hedgehog, the rest being derived either from Africa or the Orient.

ORIGIN OF THE AVIFAUNA

With the exception of the species enumerated above, the birds which are known to be resident today in southern Arabia can be shown to have been derived either from the Ethiopian region or the Indian sub-region. These are entirely arid country forms of life. Such species may have derived from savannah types, but endemism is very high in what Chapin (1932) calls the 'Somali Arid' sub-region.

Attempting to screen out only the resident land birds, and to eliminate those species of presumed Palearctic origin, a rough listing of the two areas gives the following:

	SW. Arabia		*SE. Arabia*
No. of families (including ostrich)	22	...	12
No. of species	36	...	16
Ethiopian derived	23 = 64%	...	0
Indian or Ethiopian	6 = 17%	...	3 = 20%
Indian or Mid-Eastern	7 = 19%	...	13 = 80%

The above figures include endemic species and subspecies. The latter are fairly easy to ascribe, as often they belong to species found either in the Ethiopian region or the Indian sub-region, although the latter category may include south-east European elements. Some forms such as the local resident bee-eaters and larks might be assigned to either fauna, and have been listed under the category 'Indian or Ethiopian'.

Moreau (1952: 905) states that, 'The status of the Somali . . . arid avifauna suggests . . . uninterrupted local evolution since the Pliocene, and perhaps since the Miocene. It follows that none of the Pleistocene pluvials (and no consequences of the movement in the caloric equator) can have extinguished at any time the arid environment in the areas concerned.'

Analyzing the avifauna possessed in common by Africa and the Indo-Malayan region, Moreau (1952) shows that the affinities between the two areas in birds are mostly at the family or ordinal level indicating a very long separation climatically, thus fitting with the hypothesis that free interchange of evergreen forest organisms could not have continued more recently than early Pliocene time.

The above statements are interesting as supporting the evidence derived from the fauna of Arabia, that the Peninsula has been a segment of a faunal barrier for a considerable time.

Looking also at the figures presented above it is interesting to note the degree of difference between the avifaunas of south-west and south-east Arabia. While the south-west area [included by Chapin (1932) in the 'Somali Arid'] has a clear majority of forms derived from the Ethiopian region, either similar subspecies or closely related forms, the south-east has no clear-cut cases, and only 20 per cent belonging to the category 'Indian or Ethiopian'. It is of course entirely possible that further collecting in south-east Arabia will reveal more resident forms.

In addition it is noteworthy that there are forms representing 19 per cent of the total in south-west Arabia which can clearly be ascribed to Indian or Middle-East sources, while this figure reaches 80 per cent in south-east Arabia. Therefore, it would appear that in southern Arabia, the intervening country between the Yemen and Muscat highlands forms in itself a substantial barrier to faunal interchange; supported by the fact that several bird genera such as *Turdoides*, *Ammomanes*, *Alectoris*, *Prinia*, etc. have subspecies differing from each other in the two areas. Additionally the barriers between southern Arabia and neighbouring biotic types have been strong enough to create a distinct group of residents, rather different in composition. As an example of this, in the Oman-Muscat area several Indian birds occur which have been able to penetrate no farther west than these hills. Five of these species, the Redwattled Lapwing, Senegal Dove, Indian Parakeet, House Crow, and Malabar Munia cannot be separated taxonomically from their Indian relatives.

Of the endemic birds found in southern Arabia only two are specifically distinct. One, the Blackheaded or Yemen Partridge, *Alectoris melanocephala*, seems most closely related to the Chukor Partridge of India and the Middle-East. The second species, the Taif Woodpecker, *Picoïdes dorae*, seems Asian in origin to me, closest to the Indian relict species *Picoïdes mahrattensis* and its only close relation, *P. auriceps*, of the Himalayas. *Dorae* resembles these species in its reduced and browned-out but similar patterns on the nape, lower abdomen and vent, under tail-coverts, and on the wings and tail.

Interestingly enough the sole Arabian mammal species is a similar 'relict' related to the Himalayas area, the Tahr, *Hemitragus*.

Limit of the Palearctic in Arabia

Seitz (1930; in Warnecke, 1933) says that the southern limit of the Palearctic in Arabia lies north of a line between Mecca and the northern end of the Gulf of Oman. Holdhaus (1929) makes the line a little more to the south along the 20th parallel, thus excluding Oman and Muscat completely. This would be all very well if only Yemen were to be considered in southern Arabia, and if it were to be included with the 'Somali Arid District' of Chapin (1932).

Alternatively, however, the recent work of Bates (1936) and others in western Saudi Arabia, and the increased knowledge of the birds of Muscat would seem to indicate that the southern endemisms as well as the Oriental and Ethiopian forms range farther north along the coast, and that they are not confined strictly below such lines. South-west Arabian forms such as the sunbirds, *Nectarinia*, the Fantailed Raven, *Corvus rhipidurus*, larks, bulbul, wheatears etc., all range farther north than formerly supposed, many to the edge of the Sinai Peninsula. Eastward the border should certainly be north of Hofuf and the Qatar Peninsula. Such a line would correspond to about 26°30'N. latitude.

CONCLUSION

Arabia has had a relatively stable climate since the beginning of the Pleistocene. What history is known of the past few thousand years indicates only a steady increase in dessication. Recent studies of the avifauna indicate that endemism is fairly high for such an arid region and that important relict species occur. Based on climatic history it can be presumed that three of these relicts, the partridge, the woodpecker and the tahr, as well as the Palearctic relicts, represent invasions from the Indian sub-region, or from the north, of at least pre-Pleistocene date. Of other vestigial species, remnants of pre-Pleistocene climatic conditions, at least among birds and mammals, there are none. Presumably such species remnants have been slowly extinguished over the intervening millenia.

In general, the presence of the Peninsula may be considered more of a barrier than an avenue of interchange between adjacent continents. In addition, the birds, at least, would tend to dispute the evidence advanced by some zoologists, particularly in the field of entomology, that the boundary of the Palearctic region lies far south in the Peninsula. I would suggest, therefore, that in the future the Peninsula of Arabia south of latitude 26°30'N. be considered a distinct biotic type or province (to use Semenov's term), distinct from the 'Somali Arid,' to be known as the 'South Arabian'. It is to be hoped, of course, that further field studies in the hill ranges of southern Arabia will yield additional evidence for the distinctness of this isolated area.

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OBSERVATIONS ON THE HABITS OF TWO SPIDER MIMICS OF THE RED ANT, *OECOPHYLLA SMARAGDINA* (FABR.)[1]

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(*With five text figures*)

CONTENTS

		PAGE
	INTRODUCTION	249
1.	HABITS OF THE MODEL AND THE MIMICS	249
2.	THE RELATIONS OF THE MODEL AND THE MIMICS	253
	(*a*) Discriminating powers of *Oecophylla*	253
	(*b*) Do the ants mistake the spiders for other ants?	254
	(*c*) Does *Myrmarachne* feed on its models?	255
3.	DIURNAL HABITS OF THE SPIDERS	256
4.	COURTSHIP AND MATING	258
5.	COCOONS	259
6.	LIFE-HISTORY	260
7.	CONCLUDING REMARKS	261
8.	SUMMARY	262
	REFERENCES	263

INTRODUCTION

Myrmarachne plataleoides Cambr. and *Amyciaea forticeps* (Cambr.) are two well-known spiders which mimic the Indian Red Ant, *Oecophylla smaragdina* (Fabr.). These spiders belong to two distinct families and it is interesting to see how each with its particular family characteristics has effected this simulation of the same model.

1. HABITS OF THE MODEL AND THE MIMICS

The Red Ant, *Oecophylla smaragdina*, that forms the model for both these mimics is a common ant occurring all over India. Its nests built of a number of leaves bound together with silk and guarded ferociously by the innumerable inhabitants are very familiar objects. Observations on the habits of these ants are recorded by Rothney (1890), Wroughton (1892) and Hingston (1923).

Wherever colonies of these ants exist, one can generally come across two mimicking spiders—an Attid spider, *Myrmarachne plataleoides* and a Thomisid spider, *Amyciaea forticeps*. Observations on the former are recorded by Cambridge (1869), Peckham (1892),

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[1] Read before the Thirtyfirst Session of the Indian Science Congress Association, January 1944 (Delhi).

Narayan (1915), Hingston (1927) and Mathew (1931, 1934, 1940). Observations on *A. forticeps* are recorded by Cambridge (1873, 1901), Pocock (1909), Shelford (1902), Graveley (1915), Kunhikannan (1916), Hingston (1927) and Bhattacharya (1934).

Myrmarachne plataleoides is a perfect mimic of the red ant; so perfect is this mimicry that even experienced biologists may pass it by as an ant, in the field. There is a complete copying of the external form and coloration of the ant[1]. To this passive mimicry is added a close imitation of the general movements of the model. The front legs are long and directed forwards and, whether the animal is moving about or halting, these front legs are always kept in motion and very often held raised up. In this position, frequently, the leg is bent about its middle so as to simulate the 'scape' and the 'flagellum' of the ant's antenna.

During daytime these spiders may generally be found wandering on foliage not far from red ant colonies. To distinguish the spiders from the red ants as they move amongst them is rather difficult. Still, a few minutes' observation will show one that in details of behaviour the spider is quite un-antlike and thus can be distinguished. When one of these spiders is disturbed—the shadow of an observer is enough to do this—after 'looking' at the intruder for a moment, it tries to escape. If it is on a leaf it dodges to the under-side and keeps quiet. One who has disturbed a red ant colony will realise that this is what an ant would never do. If the spider is still pursued, it moves fast in an attempt to get away. Sometimes it drops on the ground and thus baffles the would-be captor; for, once among the underlying scrub and dead leaves with many red ants moving about, detection of the tiny spider is very difficult. Most often, however, when the spider lets itself down like this, it will have a silken cable attached to the leaf from which it dropped, so that it does not always reach the ground but hangs midway. The particular behaviour often depends on the extent of the disturbance. If it is slight, the spider merely hangs by the silken cable for a minute or two and then climbs back to the leaf; but if the disturbance is greater, the cable snaps, and the spider drops down amidst the rubbish below.

Specimens collected in the field show certain variations in colour and size. Adult individuals have been met with which are not larger than three-quarters the normal size, some even so small as only half the normal size. It is interesting that this wide range of variability in size was noticed mainly in the males. Observations on some young ones which I reared in artificial cages suggest that this depends to a great extent on food; regularly and well-fed individuals at the final moult attained to the normal size and those which were underfed developed into smaller individuals. In coloration too there is variation. Specimens which were in close proximity to the red ants had the normal reddish brown colour, whereas those collected away from ant colonies had a darker colour. My breeding experiments in this case have also given some suggestions as to the probable causes of this variability. I noticed that generally, when quite highly coloured individuals were confined in cages and fed on a diet of gnats and flies, they turned several shades darker, in two or three days. This suggests that the variation in colour may be, partly at least, due to diet.

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[1] *vide* references cited above.

Amyciaea forticeps is a Thomisid spider which, by an approximation in size and coloration to the *Oecophylla*, has attained a general likeness to this ant but lacks the part-to-part correspondence so striking in the Attid mimic. Attempts to show such a correspondence have been unsatisfactory and often conflicting (see Pocock and Hingston). It is an aggressive mimic and may be seen moving about in a characteristic way in 'rushes and pauses' with a peculiar trembling movement of the first two pairs of limbs near streams of red ants or their colonies (fig. 1). It is said that these spiders keep the first pair of legs stretched in front, simulating the ant's antennae as has already been noticed in *Myrmarachne*. My observations however do not confirm this. While watching a specimen of this species for some time, one might occasionally see it in such a posture but normally it is seen to move about in a series of rushes and pauses during which the first two pairs of limbs, which are longer than the other pairs, are raised up together and brandished in a convulsive manner (figs. 2 A, 2 B and 2 C). As these two pairs of legs are held up over the head bent in a characteristic manner forming two double arches, they suggest little resemblance to the antennae of the ants.

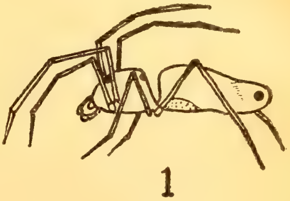

FIG. 1—*Amyciaea forticeps* in ordinary movement.

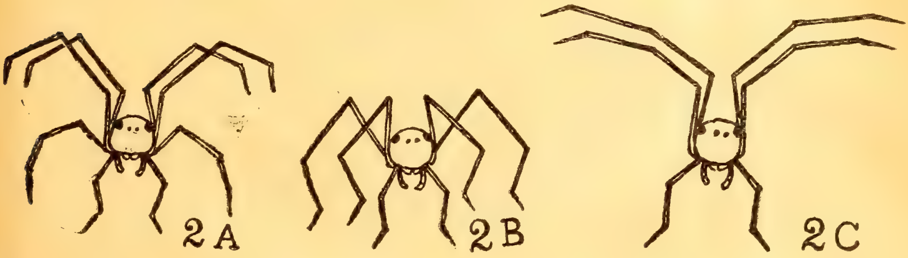

FIG. 2—*Amyciaea forticeps*. Postures presented as the animal moves along, due to the peculiar movement of the first two pairs of limbs.

2 *A*—First two pairs of limbs raised up so as to form a pair of double arches.
2 *B*—These two pairs of legs brought down together for a moment.
2 *C*—Immediately after, they are jerked upwards.

When among the ants, it is interesting to notice the extremely cautious movements of these spiders, always avoiding the main lines of the ants. Confronting one of the ants, the spider immediately dodges to the opposite side of the leaf moving dexterously sideways in true Thomisid fashion, or it may drop on its silk line 'safety cable'. Though it shuns the ant in the open foliage it is a regular hunter of these ants, stalking and feeding on them. It waits watching for an unwary stray ant and, when it sees one, cautiously approaches it and finally makes an unerring spring.

Hingston (1927) remarks that these spiders make silken retreats from which they emerge to capture the ants. I have failed to see any retreats made by these spiders; they do not make any. They hunt their prey in the open, lurking in the paths of the ants.

In February 1930, I kept a few of these spiders and two red ants in a glass box. After wandering about for some time one of the spiders was seen stalking an ant. Facing the ant the spider retreated a little and waited for its chance. As it thus waited the body was balanced on the 3rd and 4th pairs of legs, the 3rd pair directed forwards and the 4th pair backwards. The two pairs of legs in front are held up together and gracefully bent at the joints forming a pair of double arches and are kept constantly quivering in a characteristic way. This quivering movement of the limbs together with the two conspicuous black spots on the abdomen suggesting a pair of eyes gives the picture of a struggling ant. Probably this serves as a lure to the ant. Whereas an ant under normal conditions may not mistake a spider as it moves along for a member of its own species, it is quite possible that a small ant-like body with the legs all quivering may suggest an ant in trouble. The ant immediately took up the usual alarm attitude, paused, raised the body on the legs, held the antennae up and bent the abdomen sharply over the thorax. This was the spider's chance. It quickly moved to a side and by a sudden unerring spring jumped on to the back of the ant and thrust its chelicerae into the ant's head (fig. 3). Immediately the ant bent its body double and was motionless. The spider left it for a moment but soon returned and began sucking it. Meanwhile the other ant which was in the cage became highly alarmed and, moving hurriedly with mandibles held wide open, came across the spider quietly enjoying its meal; in a moment the spider was struggling between its mandibles, helpless.

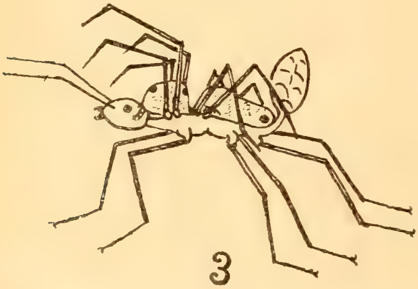

FIG 3—*Amyciaea forticeps* springing on an ant.

A similar observation regarding the hunting habits of *Amyciaea* has been made by Mrs. Drake as recorded by Graveley (1915). Though this appears to be the method of capture as observed in cages, my observations in the field show a different behaviour. One evening while searching for spiders near an *Oecophylla* colony, I came across a stout *Amyciaea* stalking a stray ant. It moved in its characteristic manner, took up the 'luring posture', and then made the spring; the ant struggled, and the next moment I saw the hunter and the hunted tumbling down together from the twig. The spider never lost its firm hold on the prey but as it rolled down, it glued to the twig its 'safety cable' so that, instead of falling down on the rubbish below where the ant probably could make a good struggle, it hung down from the twig on the slender cable in mid air with the ant struggling between its chelicerae (fig. 4). Here the spider was 'at home' and the ant helpless. After hanging in this position for a while the spider began sucking its prey. Sometime later it climbed back to the twig carrying the prey along with it and there continued to suck it at different parts.

Since then I have observed on several occasions spiders of this species enjoying their repast hanging in mid air on their threads from the open foliage. This is certainly safer since red ants move about in the vicinity and, if one of them surprises the spider, the latter would have no way of escape as was noticed previously in one of my observation cages.

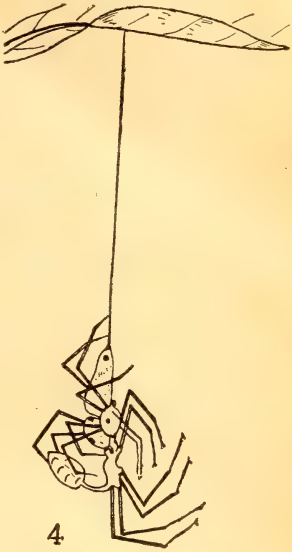

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FIG. 4—*Amyciaea forticeps* hanging from a silken thread and sucking a captured ant.

2. THE RELATIONS OF THE MODEL AND THE MIMICS

Amyciaea feeds on its models and so its close association with ant colonies is easy to understand. But it is difficult to see why the formidable red ants wink at the intrusion into their midst of these dangerous assassins, especially when we realise how uncourteous these ants generally are to intruders, and how fiercely and tenaciously they defend the colony and the nest from outside interference. It is surprising, similarly, to note the same apparent indifference shown by these ants towards the Attid mimic *M. plataleoides* which also enjoys the closest proximity to these insects. It is commonly suggested that by their ant-likeness they are mistaken by the ants for members of their own community and that thus they are tolerated. Regarding *A. forticeps* it is claimed that in this false garb it can get into ant colonies unrecognised and thus have plenty of unsuspecting prey on which it can feed with impunity. This interpretation cannot, however, be held in the light of what we know of insect vision on the one hand and of the discriminating instincts of the ants on the other. We have no reason to imagine that the ants are deceived by the false garb of the spiders so as to mistake them for other ants. The behaviour of the ant when it faces one of these spiders is ample evidence that it is not in any way deceived as to the real nature of the intruder.

(a) *Certain observations on the discriminating powers of Oecophylla*

Two individuals from a distant colony of red ants were introduced on a shrub where there was a thriving colony of these ants kept under observation. These moved about on the leaves. One of them soon came across one of the smaller type of workers of the colony. The latter immediately 'recognised' the stranger and, without waiting for any help or running away scared by a larger opponent, fearlessly attacked it. It gripped one of the legs of the intruder with its mandibles and pulled it hard but the other struggled and bending its body caught the enemy by the neck and severed the head from its body. The carcase of the defender rolled down the leaf, but its head never lost its firm grip. Meanwhile some half a dozen members of the colony had come on the scene and gripped the intruder at different places. Two held the antennae and pulled them tightly in opposite directions. Others caught hold of the legs and pulled them apart, while others got on the body and began to bite and tear viciously.

While they were so uncourteous towards members of strange colonies, they appeared to be very considerate towards individuals of their own colony which were kept away from them for some time. On their being restored they were received with apparent cordiality and were not attacked. The *Oecophylla's* sense of distinction goes a step further. One family seems to establish more than one colony —sometimes quite a number of colonies, grouped close together on the same or adjacent branches. Individuals of these different colonies, but all belonging to the same family, seem to recognise each other perfectly well for, when they meet, there is no show of hostility but they seem to get on in the most friendly manner. Into a nest which was under observation I introduced a worker from one of the adjacent colonies whose proximity to this nest convinced me that they must form one family. It was not attacked.

These observations show that: (1) *Oecophylla* can readily recognise members of its own colony (2) It distinguishes members of friendly and allied colonies with little difficulty and accords to them the proper cordial treatment (3) It recognises members of other colonies and is quite inhospitable to them.

(*b*) *Do the ants mistake these spiders for other ants?*

Possessing such instincts of discrimination as observed above, it is highly improbable that the ants would be deceived by the false garb of these spiders with its many imperfections. My observations convince me that the *Oecophylla* recognise these spiders as strangers and are alarmed. I have often closely watched specimens of *M. plataleoides* as they move about on plants with streams of red ants. The spider is very careful to avoid the ants, and if it comes across one, it immediately beats a hasty retreat and escapes. The ant recognising it (or recognising that something is amiss) assumes its alarm attitude which gives the spider time to escape. Should the ant pursue, the spider quickens its pace, dodges under a leaf, or as a last resort lets itself down by a thread and hangs suspended in air where the ant cannot pursue it. The ant, losing its quarry, abandons the chase. If somehow this method of escape is rendered impossible or prevented, the ant pounces upon it in the most relentless manner and carries it triumphantly to the nest. This applies equally truly to *Amyciaea*. Coming across the foraging ants, this spider dodges and escapes or drops on a silk thread as *Myrmarachne* does. Only stray ants are 'lured' in the characteristic manner described above and secured as prey. It never behaves as if it felt safe near the ants but is ever on the alert. A moment's neglect or ease may find it being crushed between the mandibles of the ant! The safety of these spiders then from being attacked by the red ants amongst whom they live depends, not so much on their deceptive garb though commonly thought to be so, as on their cleverness and quickness in perception and movements. Their sight and nimble movements in any direction as may be necessary and their possession of the 'safety cable' ready for use at any time, alone make them safe in the midst of these vicious ants. What then, it might be asked, about the protective value of ant mimicry? By looking like ants and haunting their vicinity, these spiders do secure comparative safety from their usual enemies, as has been pointed out by me in a previous paper (1934). But we are not to think that the false garb in any way deceives the ants themselves.

(c) *Does Myrmarachne feed on its models?*

Does *Myrmarachne* feed on its models as *Amyciaea* does? The few observations recorded that it does were quite likely made as a result of confusion between these two mimics. My observations extending over many years and made under diverse conditions show that *M. plataleoides* does not feed on the red ants. I have also made some tests with other Attid mimics and their models; I have never seen any Attid mimic attacking its model. This is quite a contrast to the Clubionid and Thomisid mimics which regularly hunt and prey on their models.

Though *Myrmarachne* does not feed on the red ants, it still keeps persistently close to the ant neighbourhoods. This may suggest that there is some biological interrelation between these animals. Many times I have seen these spiders getting as close as possible to the nest of the ants; and occasionally seen mature or immature individuals waiting in their 'retreats' on the underside of a leaf which was just an inch or two below the nests of these ants. But I have never seen them getting any further.

While camping at Karupanthode, Travancore Reserve Forests, in December 1929, I came across a red ant nest which was deserted by the occupants. On opening it I found a female *M. plataleoides* inside. Sometime later in Parur, North Travancore, I came across a male and a female *M. plataleoides* in a 'mating nest' within a deserted nest of *Oecophylla*. Probably the spiders might have got in after the nests were deserted by the ants. But, on another occasion in the summer of 1931 at Parur I found a female spider in a nest of *Oecophylla* still tenanted by a few ants. I have ascertained definitely that these spiders do not live in ant nests as certain other spider mimics do. The above observations therefore merely suggest that under certain conditions they may enter ant nests.

It seemed that the larvae and pupae of the ants might be the attraction for these spiders. To see if these would be taken and relished as food, I put a few ant pupae in a cage where there were a few spiders. Since they ordinarily take only moving prey I was not expecting any positive results. But in a few minutes, when I returned to the cage, I was quite surprised to see the spiders each with a pupa in its jaws and busy sucking it!

Later, a red ant's nest from which most of the ants were driven off leaving only a few larvae and pupae with a few smaller workers who persisted in remaining with the pupae, was gently dropped into one of the cages containing a few spiders. After a few minutes the spiders approached the nest with great caution. They moved carefully halting at every step. Getting on to the leaf on which the nest was, they moved about on its outer side. One casually got on the other side; it must have seen the ants guarding the pupae, for it immediately dodged to the opposite side of the leaf. As it was thus approaching the pupae it showed evident signs of caution or fear; for, at the slightest movement of the ants or even of the cage, it would suddenly run back. After some time, however, I saw each of these spiders holding a pupa in its jaws! How they did it I was not able to observe.

Once while collecting egg cocoons of these spiders I came across one cocoon near which was a nest of the small brown ants. In the cocoon the eggs had hatched and the spiderlings had completed their second moult within the cocoon and had become quite ant-like; their size and dark coloration made them appear very similar to the brown ants which were moving about on the leaf. This relation appeared quite interesting. The nest was taken to the laboratory and put in a glass cage. In doing this I evidently disturbed the young spiders as well as the ants; for, they became restless and leaving their nests began to wander about the glass cage. The disturbed ants according to their universal custom had each taken in its mandibles a larva or pupa and were wildly moving about for some time. Finally, they settled in a corner of the glass cage with their charges still in their jaws. Afterwards two of the spiderlings were seen moving to the new ant settlement; getting close to it they spun their retreats and settled close by. It seemed that these spiderlings too, like their parents, may be larva and pupa stealers, but these exploit, not *Oecophylla*, but the small brown ants which they mimic.

An attempt was made early in 1932 to see if a spiderling could be reared from its earliest stages on a diet exclusively of ant larvae and pupae. It was quite a success and it is specially noteworthy that the specimens continued to be healthy and vigorous through all the stages.

These studies show that quite possibly these spiders are larva and pupa stealers of their models. This may be only a step towards becoming actually aggressive; for, from the habit of feeding on larvae and pupae of the models to feeding on the models themselves is only a small step—yet, one accompanied by greater risks and therefore perhaps never taken.

3. DIURNAL HABITS OF THE SPIDERS

During daytime *M. plataleoides* wander about in search of prey and towards dusk they generally spin silken shelters or retreats in which they rest for the night. They have seldom been seen to go back to their old retreats, being satisfied with making a fresh retreat for the night wherever they chance to be. When confined in small cages they have quite often been noted to use the old retreats if they are not badly torn. The females, with their cocoons and guarding the eggs, stray out only a short distance from their 'nests' and return soon to their charge.

My observations show that these spiders 'rest' in their retreats during the whole night and do not stir out after nightfall under normal conditions. Some of the observations and experiments which have convinced me that these spiders are not nocturnal were given in detail in a former paper (Mathew, 1931). The following observations may be noted:

1. In the field, towards dusk, these spiders can be seen making their retreats in which they remain all through the night.
2. When kept in observation cages they do the same.
3. At night, observing an individual in its retreat we note that it fails to observe the intruder's approach; in the daytime it would be almost impossible to approach them without being noticed.
4. At night when an individual is within its retreat, if a needle is taken to its front and waved to and fro, it is not perceived. Only when touched by the needle does it become aware of any disturbance. But even then it does not realise the real nature of the disturbance; it simply gets out of the retreat and runs about in a confused manner.
5. A specimen was kept in a cage and occasionally fed on tiny insects. One night after the spider had retreated into its nest, a small insect was introduced into the cage to see if the spider would attack it, which could be expected if it were nocturnal. But the next morning the insect was found alive and the spider still at rest. A few minutes later the spider got out of its retreat and soon afterwards caught the insect and sucked it.

The retreats made for the night are never so thick and well built as the moulting chambers. They often consist of only a canopy over the spider resting on a leaf; the canopy being narrower towards the ends, both of which are open. The spider can conveniently turn about within this retreat. As it rests under the canopy the forelegs are stretched out forwards and upwards, so as to be in contact with the front part of the canopy; the tarsi are bent downwards so as to stretch across the front opening. The last pair of legs are stretched backwards in a similar manner with the tibia in contact with the dome and the tarsi resting on the floor stretched across the posterior opening. Thus both the openings are guarded and at the slightest disturbance, whether on the dome or at any of the openings, the spider is on the alert. If the disturbance is from behind, it immediately turns around within the retreat and faces the intruder. If however the disturbance is sufficiently serious, the spider rushes out wildly and escapes.

Amyciaea too is diurnal. During the day it is active near the colonies of the red ants. During the night it rests. However, it does not make retreats as *M. plataleoides* does. On the other hand towards nightfall it spins irregular tangles of silken threads stretched between adjacent leaves or twigs and suspending itself in the middle of this framework, it rests secure (fig. 5). The two front legs on either side are held together and stretched outwards at right angles to the length of the body in a straight line. The third pair of legs which is the smallest pair, each grips one of the filaments while the last pair is directed backwards holding on firmly to the strands behind. In such a position it can rest secure from the predacious red ants which may be moving in the vicinity.

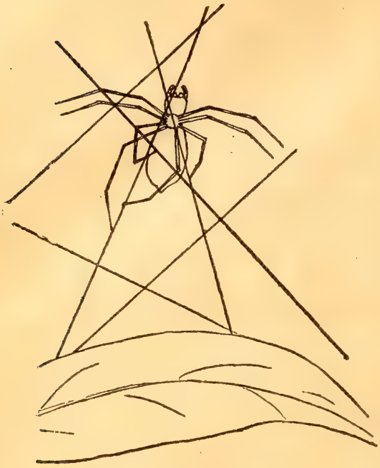

Fig. 5—*Amyciaea forticeps.* Position of night repose.

4. Courtship and Mating

The courtship and mating habits of *M. plataleoides* have been described by me in a previous paper (Mathew, 1940). It was shown that pairing normally takes place in 'pairing nests', without any preliminary courtship.

Regarding the courting habits of *Amyciaea*, Bhattacharya (1934) has recorded certain observations. The following observations of mine may be added.

On June 4, 1930 I saw a stout female *Amyciaea* on a portia twig along which a stream of red ants was moving. On an adjoining leaf was a male, smaller and of a more slender build than the female. I secured them both in tubes and later put them together in a cage. Considering their aggressive nature I hesitated to put them together but there was no show of hostility; they moved about the cage in their characteristic way, in rushes and pauses, the anterior two pairs of legs being stretched out and flourished with a quivering movement during the pauses. This has been thought to have some special relation to courtship. It is referred to as a display of their graceful movement of legs in courtship. But I have shown above that they behave in this way in their ordinary movements. Soon they came near each other and then, without any preliminary 'courtship', the male made a sharp jump on to the back of the female as he would pounce upon his prey. He took up his position above her abdomen, facing in the same direction as she. This is unlike the positions taken up by male and female *M. plataleoides* in pairing, who face in opposite directions and both have their legs resting on the floor. Here, the male plants all his legs on the female's abdomen leaving her perfectly free to move about. While the male adjusted his position on the female's back, she remained quiet in a crouching attitude. Soon, however, the female resumed her normal posture and on the slightest disturbance, would move about carrying the male on her back. She was in fact quite free to move and continued to do so in the cage for about a quarter of an hour. The movements then gradually stopped and she became quiet. The male felt for the epigynum of the female with his palpus and the sperm transfer was effected. They remained in this position for about half an hour, and for most of this time they were quiet except for an occasional quivering movement of the first two pairs of limbs. After copulation they separated and wandered apart.

Here we notice certain marked differences from the pairing habits of *M. plataleoides*. It is clear that in *Amyciaea* there is no preliminary courtship. Their 'recognition' or 'realisation' of each other seems to be instantaneous and, the moment the male has planted himself on the back of the female, the latter's feeding instinct is suppressed and she is ready to pair. Again, in *Amyciaea* pairing takes place in the open and not in any 'pairing nests'. *M. plataleoides* withdraws into specially constructed nests for pairing, and it was pointed out in that connection (Mathew 1940) that this was necessary, since they live in close proximity to the predacious red ants which might at any time surprise them. But in *Amyciaea*, which too lives in identical surroundings the necessity for retreating into a nest is dispensed with since the female during pairing is completely free to move about carrying the male on her back. If surprised by a forager ant, she can dodge under cover and escape.

5. COCOONS

Both these spiders make special cocoons in which they lay their eggs, and the 'mothers' remain guarding them long after the eggs have hatched out—till the spiderlings have become fit to leave the cocoons.

In *M. plataleoides* the cocoon is generally spun on the upper surface of a leaf though, during the rainy season cocoons have been seen on the underside of large leaves. On the surface of the leaf a small sheet of silk is first spun—this in confinement takes a long time. The eggs are laid usually in one group and arranged side by side in a single layer, in contact but not stuck to each other. Over this a fine silken felt sheet is made completely enclosing the eggs, its edges being firmly attached all round to the surface of the leaf. This layer is reinforced by another or sometimes two or more layers over it closely adherent to it. In many instances I have seen a second clutch of eggs added after the first layer of felt has been fully spun, so that this clutch of eggs lies between the first and second layers of felt. The second clutch when present contains a smaller number of eggs compared to the first; while the first clutch contains about 20 eggs, the second has only 5 or 6 eggs.

After the felt layer over the eggs has been completed, the spider takes up her position over it; above her, she spins a dome-like canopy enclosing herself and the cocoon with the eggs. This canopy is of the usual type with an opening at each end. Sometimes there is an irregular scattering of white fluffy silk on the wall of this dome recalling the 'stabilimenta' of some of the web-spinning spiders. Inside this retreat she remains till the eggs are hatched and the spiderlings ready to leave the cocoon. Only rarely she leaves the cocoon, probably in search of food. The emaciated condition of most of the spiders guarding the cocoons shows that they do not venture outside very frequently, even for feeding. When disturbed they appear very unwilling to desert their precious charge. During the monsoons I have come across a few nests with eggs but soaked in water. The mothers were found dead in their 'on guard' positions. Perhaps the sudden rains wetting the whole nest made their escape impossible.

Generally the cocoons are seen singly, but occasionally one comes across numbers of these aggregated on a single leaf. This tendency to aggregate during egg laying has never been seen in *Amyciaea*.

Amyciaea too makes a cocoon which the female guards with great tenacity. The cocoon is generally made on the concave inner surface of a leaf the edges of which are drawn together by two strong bands of silk. On the leaf a silk sheet is spun over which the eggs are laid. The eggs are not arranged in a flat row as in *M. plataleoides* but all stuck together in a round ball. In *M. plataleoides* they are separate, not stuck to one another. Over the mass of eggs a thick felt is woven the edges of which are fused to the surface of the leaf all round. Over this felt the female takes up her position in true Thomisid style. There is no canopy over her as was noticed in *M. plataleoides*.

6. LIFE-HISTORY

The life-history of *M. plataleoides* has been described by me in a previous paper (Mathew, 1934). It was shown that the young too are ant-like and mimic different species of ants according to their size and coloration at their different stages, and this interesting form of mimicry was termed '*Transformational mimicry*'. It was seen that the young too share the advantages of mimicry; thus solving an old problem of the protective methods of the young of those spiders which are protected by mimicry as adults. This phenomenon introduces certain complications for the field naturalist. Collecting ant mimics he often comes across many spiders mimicking common ants. While it would be interesting to note models and mimics, their habits and behaviour, since many of them would be immature, their identification would be impossible unless the life-history of each species has been fully determined. A spider which when adult mimics a certain ant is observed in its early stages to mimic other ants out of necessity, as shown in the paper referred to (Mathew, 1934). Another fact to be noted is that the ants which form the models for the immature forms of certain spiders have certain other spiders mimicking them in their adult stages. Thus the small biting ant *Solenopsis* which is mimicked by *M. plataleoides* in one of its early stages, has a small species (very near *M. spissus*) mimicking it as adults. The small black ant *Prenolepis* is mimicked by an early stage of *M. plataleoides* as well as early stages of certain black mimics like *M. manducator* and *M. ramunni*.

The form of the cephalothorax which is an important basis for specific distinction attains the characteristic shape only when adult or in the later stages. The cephalothorax of an immature form is different from that of the adult and often resembles that of some other species. The falces, sternum and the epigynum which are such distinctive features of most species attain the typical form only in the adult stages.

In the development of *Amyciaea* no such transformational mimicry is seen. The young ones are of the typical crab-spider form with light green coloration without any ant-likeness. The two pairs of front legs which are the longest as in the adult are marked with certain reddish bands and these legs are held up and nervously brandished like the performance of the adult. The ant-likeness is assumed only in the later stages. As these spiders are of a more shy and retiring nature like the typical Thomisidae, contrasting with Attidae which more boldly expose themselves in the open, special protective methods in the earlier stages may not be so essential.

7. Concluding Remarks

It was shown that the mimicry seen in *M. plataleoides* is most perfect when the spider is in movement in the company of ants. With reference to protective coloration Beddard (1892) has pointed out, and it is now well recognised, that it is not merely the coloration and pattern that contributes to safety but also immobility. A recent writer, (Cott, 1940) expresses this as follows: 'Compared with stillness cryptic coloration is relatively unimportant; but combined with stillness it is all important'. An individual however protectively coloured, if it actively moves about, runs the risk of being conspicuous. But in a true mimic of the type of this spider—which copies not an immobile object but an active organism—we find that the perfection of the mimicry depends not so much on the external appearance as on the imitation of movements. Thus in these two types of resemblances, one copying a passive object and the other an active one, safety seems to depend primarily on the passivity of the former and on the activity of the latter.

The purpose of ant mimicry by spiders is believed to be either protective or aggressive. The value of ant mimicry as a protective device has been discussed in a previous paper (Mathew, 1934) where I have shown that the objections which are ordinarily brought forward against this have arisen as a result of the faulty way in which this function is usually explained.

Amyciaea is a mimic of a different type. Its mimicry is termed aggressive since it feeds on the models, and the protective value of its mimicry is not stressed. It has been shown above that the ants never mistake these for other ants and that both these mimicking spiders enjoy the proximity of ants not by virtue of any simulating powers but only by their shy nature and possession of the safety cable. The role of mimicry here as an aid to aggression has been explained. It is not an actively moving ant that is mimicked but a struggling or dying ant, thus serving as a 'lure' for would-be prey. This explains why the mimicry appears far from perfect and why there is no imitation here of the normal gait of the ant. In addition the mimicry may also have a protective value. Though these spiders are aggressive towards their models, it does not mean that they are immune from the attacks of their own numerous enemies.

For protection through ant-mimicry it is essential that the mimics should be amongst, or at any rate, close to the models. Field observations show that they are actually seen in the proximity of the red ants. What can be the incentive that keeps these mimics in their proper surroundings?

Amyciaea feeds on the red ants and so its seeking proximity to the latter is easy to understand. It has been shown above that *M. plataleoides* too has an attraction since it steals and preys on the larvae and pupae of the ants. The young ones of this species which mimic the *Prenolepis* ants have been seen to steal the larvae and pupae of these ants and, evidently for this purpose, to keep their company. In a previous paper (Mathew, 1935) I have shown ants mimicking bugs feeding on plants which are also frequented by the models for certain exudations of these plants; model and mimic frequent the same plant for food and thus the mimic gets the requisite surroundings.

Beddard (1892) in considering a similar question says: 'It is not generally believed that insects and other animals that are protectively coloured deliberately select for a temporary resting place a situation—whether it be a trunk or a leaf—that harmonises with their own colour. The theory is that their colours have been modified in accordance with their usual environment, those that habitually settle among trees being green and so forth. It has, however, been stated that a small black moth (*Physis carbonariella*) is constantly met with in patches of underwood that have been burnt; its dusky hues approximate with the colour of charred wood.'

The theory that colours have been modified in accordance with their usual environments, while it might explain how a particular pattern has been arrived at in the course of generations, does not explain how a particular individual having a particular pattern gets into the proper environment. This difficulty would not arise in the case of fixed organisms or organisms which move only to a small extent; but in an animal with active habits like these spiders the question of being in the proper surroundings is very important.

8. SUMMARY

Observations on two ant-mimicking spiders, the Attid *Myrmarachne plataleoides* and the Thomisid *Amyciaea forticeps*, mimicking the common red ant *Oecophylla smaragdina*, are recorded. *M. plataleiodes* mimics not only the external form but also the movements of the model. *Amyciaea* is alleged to raise the first pair of legs to simulate the antennae of the ants but this is denied. It keeps both the first and second pairs of legs raised, bent and quivering in a characteristic manner serving to 'lure' the ants. The usual claim that by their mimicry these spiders are mistaken by the ants for other ants and thus they procure plenty of unsuspecting prey, cannot be accepted in view of the discriminating powers of *Oecophylla* experimentally shown.

Both these spiders are diurnal and their night retreats are described. *Amyciaea* 'sleeps' suspended on a sling made for the night. Mating of *Amyciaea* is not preceded by any courtship as is sometimes suggested—the nervous movements noted when two individuals come together being observed also as they ordinarily move about. The young of *Amyciaea* do not mimic ants, contrasting in this respect

with *M. plataleoides* whose young mimic small species of ants exhibiting the phenomenon of *Transformational Mimicry.*

The purpose of ant mimicry in both these spiders is protective—from the usual enemies of spiders. In *Amyciaea* it is, in addition, *aggressive*—helping to lure and capture stray ants. For protection through mimicry, it is essential that the mimic be amongst or near the models. How this is brought about in the case of these spiders is discussed.

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WILD LIFE PRESERVATION AND SANCTUARIES IN THE UNION OF BURMA

BY

U TUN YIN, B.A., B.C.S. (Selection Grade) (Retd.)

(*With a map*)

INTRODUCTION

There are eleven Wild Life Sanctuaries comprising 914.87 sq. miles in the Union of Burma.

Pidaung Wild Life Sanctuary (279.70 sq. miles) is situated in the Kachin State. Part of Shwe-U-Daung (45.00 sq. miles) and Taunggyi (6.20 sq. miles) are situated in the Shan States, Kahilu (62.00 sq. miles) and Mulayit (53.51 sq. miles) are situated in the Kaw-Thu-Lay (Karen) State. The remaining sanctuaries are situated in Burma proper. They are:

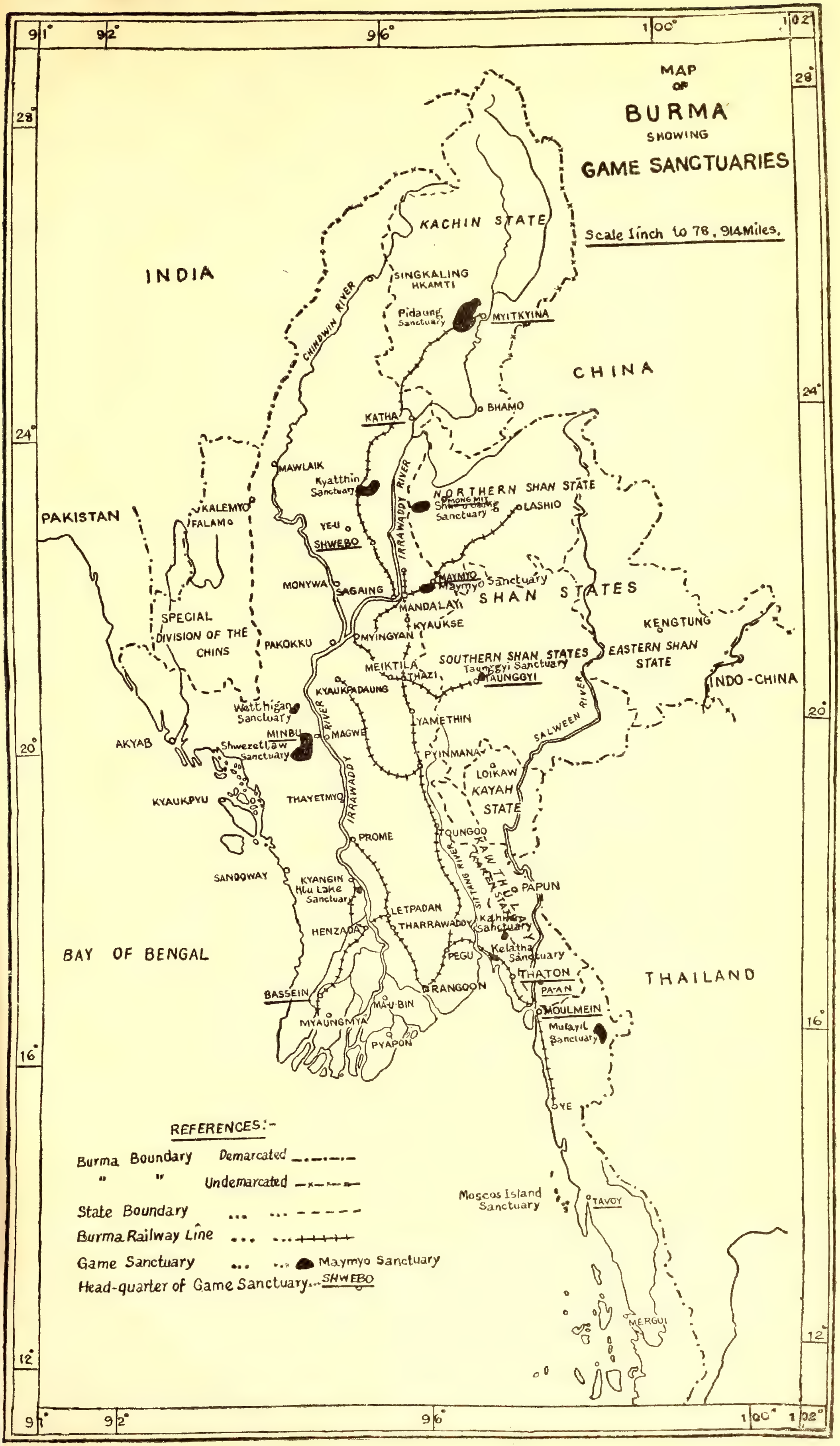
Shwe-U-Daung	81.00	sq. miles
Kyatthin	104.00	,, ,,
Shwezettaw	213.40	,, ,,
Maymyo	39.91	,, ,,
Moscos Islands	19.00	,, ,,
Wettigan	1.70	,, ,,
Kelatha Hill	9.45	,, ,,

Shwe-U-Daung and Kahilu were constituted primarily to protect the few remaining specimens of *Dicerorhinus sumatrensis* from extinction, Shwezettaw and Kyatthin to perpetuate *Panolia eldi thamin* Thomas, the typical deer of Burma. Pidaung was a natural haunt of various species of wild life, except rhino, and was the show place before 1940. Unfortunately it has been shot out during the last World War. Maymyo, Taunggyi and Kelatha Hill are refuges for various species of land birds and Wettigan Lake is a refuge for waterfowl.

Immediately prior to the British evacuation in 1942, preliminary notifications were issued in respect of Htu Lake in the Henzada Forest Division for waterfowl, and Byingye Hill in the Yamethin Forest Division to protect the remaining accessible heads of goral. The Game Warden was appointed Settlement Officer in respect of these two proposed sanctuaries. As the post of Game Warden is at present held in abeyance, settlement cannot yet be carried out.

LEGISLATION

Section 6 of The Burma Wild Life Protection Act, 1936, reviewed in the Society's *Journal*, [Vol. 39 (3), pp. 606-607, 1937] affords


MAP OF BURMA SHOWING GAME SANCTUARIES
Scale 1inch to 78.914Miles.
91°
92°
96°
100°
102°
28°
24°
20°
16°
12°
INDIA
CHINA
PAKISTAN
THAILAND
INDO-CHINA
BAY OF BENGAL
KACHIN STATE
SINGKALING HKAMTI
Pidaung Sanctuary
MYITKYINA
BHAMO
KATHA
CHINDWIN RIVER
IRRAWADDY RIVER
MAWLAIK
Kyatthin Sanctuary
NORTHERN SHAN STATE
MONG MIT
Shwe-u-daung Sanctuary
LASHIO
KALEMYO
FALAM
YE-U
SHWEBO
MONYWA
SAGAING
MAYMYO
Maymyo Sanctuary
SHAN STATES
MANDALAY
KYAUKSE
KENGTUNG
SPECIAL DIVISION OF THE CHINS
PAKOKKU
MYINGYAN
MEIKTILA
THAZI
SOUTHERN SHAN STATES
Taunggyi Sanctuary
TAUNGGYI
EASTERN SHAN STATE
KYAUKPADAUNG
Watthigan Sanctuary
MINBU
MAGWE
AKYAB
Shwezettaw Sanctuary
YAMETHIN
SALWEEN RIVER
PYINMANA
LOIKAW
KAYAH STATE
KYAUKPYU
THAYETMYO
PROME
TOUNGOO
SITTANG RIVER
KAWTHULAY
KAREN STATE
SANDOWAY
KYANGIN
Htu Lake Sanctuary
PAPUN
LETPADAN
THARRAWADDY
Kahilu Sanctuary
HENZADA
PEGU
Kelatha Sanctuary
THATON
PA-AN
BASSEIN
RANGOON
MA-U-BIN
MOULMEIN
MYAUNGMYA
Mulayit Sanctuary
PYAPON
YE
Moscos Island Sanctuary
TAVOY
MERGUI
REFERENCES:-
Burma Boundary Demarcated
" " Undemarcated
State Boundary
Burma Railway Line
Game Sanctuary ● Maymyo Sanctuary
Head-quarter of Game Sanctuary... SHWEBO

complete protection to rhinoceros, tapir, peafowl, Argus pheasant and masked finfoot. But the proviso to the said section reads as follows:—

'Provided that it shall not be an offence for any physician or druggist to possess or sell, or for any person to possess for private medical purposes rhinoceros blood or any preparation thereof.'

Under section 7, no person shall hunt any of the following animals or knowingly possess or sell or buy them alive or dead or part or product thereof save under and in accordance with the conditions of a licence:—

'Elephant, bison, tsaing, thamin, serow and goral.'

Section 8 prescribes a close season from 15th June to 30th September for hog-deer, sambar and barking-deer and from 15th March to 30th September for all species of pheasant (except Argus pheasant), partridge, junglefowl, quail, wild duck and teal.

Under sections 26 and 28, the Burma Wild Life Protection Rules were published in the Department of Agriculture and Forests Notification No. 2, dated the 2nd January 1941. The rules came into force on the 11th January 1941.

The Scheduled Areas Wild Life Protection Regulations (Regulation No. 1 of 1941) was published by the Defence Department, Political Branch, on the 10th February 1941. It extends to the following areas:—

(i) The Arakan Hill Tracts;
(ii) The Chin Hills District;
(iii) So much of the Kachin Hill Tracts of the Myitkyina, Bhamo and Katha Districts as is included in the Myitkyina, Bhamo and West Katha Forest Divisions;
(iv) The Shan States of Hsawnghsup and Singkaling Hkamti and the Somra Tract in the Naga Hills District.

The provisions of the Burma Wild Life Protection Act, 1936, shall apply to the areas mentioned above subject to the modifications as set forth in the Schedule.

Firstly, the Wild Life Protection Regulation has been extended only to the Kachin Hill Tracts in the three Forest Divisions—Myitkyina, Bhamo and West Katha.

The Kachin Hill Tribes Regulation 1895 has been declared as the law applicable to the hill tribes in the following tracts:—

(i) The Kachin Hill Tracts of the Bhamo, Myitkyina, and Katha Districts;
(ii) The Hill Tracts of the North Hsenwi State; and
(iii) The Kodaung Hill Tracts of the State of Mongmit.

This Regulation applies to the undermentioned tribes in the abovementioned tracts:—

(i) Bhamo and Myitkyina Districts: Kachins, Yawyins, Nungs, Marus, Lashis, Atsis, and Chins (Nagas); and also Shans and Gurkhas permanently resident in a hill tract. (*N.B.* The term *shan* includes *Shan-gyi*, *Shan-tayok* and *Shan Burmese* but does not include the Shan Burmese in the hill tracts of the Mogaung Sub-Division.).
(ii) Katha District—Kachins.
(iii) North Hsenwi—Kachins.
(iv) Mongmit—Kachins and Palaungs.

The Hkamti Long Administration Order, 1926, applies to the eight Shan Circles in the Putao Sub-Division of the Myitkyina District:

(i) Lonkhun, (ii) Mansi, (iii) Lonkyein, (iv) Mansekhun, (v) Mannu, (vi) Langdao, (vii) Mongyak, and (viii) Langnu in Hkamti Long.

The remainder of the Sub-Division is part of the Kachin Hill Tract and has the Kachin Hill Tribes Regulation applied to it.

Under Section (3) sub-section (1) of the Kachin Hill Tribes Regulation, notwithstanding anything in any enactment in force, this regulation and the enactments in the Schedule annexed shall be deemed to be the only enactments which apply to members of a hill tribe in a hill tract.

Under Section (3) sub-section (2) no other enactments shall be deemed to apply to members of a hill tribe in a hill tract.

To sum up, the position as the writer can interpret it is as follows:

The Burma Wild Life Protection Act does not apply to the Kachins, Yawyins, Nungs, Marus, Lashis, Atsis and Chins (Nagas); and also Shans and Gurkhas permanently resident in a hill tract in the Bhamo and Myitkyina District, and Kachins in the Katha District.

Regulation 1 of 1941 is applicable only to non-members of a hill tribe resident in hill tracts of Myitkyina, Bhamo and West Katha Forest Divisions.

Burma became a Sovereign Independent Republic known as 'The Union of Burma' on the 4th January 1948.

Section 226 sub-section (1) of the Constitution of the Union of Burma reads: 'Subject to this Constitution and to the extent to which they are not inconsistent therewith, the existing laws shall continue to be in force until the same or any of them shall have been repealed or amended by a competent legislature or other competent authority'.

Under Section 6 of the Constitution Myitkyina and Bhamo Districts form a constituent unit of the Union of Burma known as 'The Kachin State'.

The few surviving specimens of *Dicerorhinus sumatrensis* in the Nam Lang Valley, Putao Sub-Division and Kungsai tract, Kamaing Sub-Division, Myitkyina District are wholy unprotected. And so are other rare animals such as the takin, musk deer, panda, goral and serow.

If the present surviving specimens are to be saved, it is necessary to extend the Burma Wild Life Protection Act to the whole of the Kachin State and at the same time amend the Kachin Hill Tribes Regulation and Hkamti Long Administration Order.

Under Section 196 of the Constitution the Chin Hills District and the Arakan Hill Tracts form a Special Division of the Chins.

The Chin Affairs Council has gone ahead by extending the Wild Life Protection Act, 1936, to the whole of the Chin Special Division by the Chin Special Division (Extension of Laws) Act, 1948 (Act No. 48 of 1948).

Under section 5 of the Constitution the Federated Shan States and Wa States form a constituent unit of the Union of Burma.

In 1937, the Federal Council of Shan Chiefs decided that the application of the Shan State Game Rules should cease to extend to those States or parts of States over which the Forest Act has ceased to apply, and also to Block VI of the Southern Shan States Forest Division which lies in the remote Mekong drainage of Kengtung State.

The protection of game in areas to which the Shan States Game Rules, 1929, do not apply was undertaken by the Chiefs concerned. The Chiefs agreed to issue prohibitory orders under customary laws.

(1) Affording protection to bison, serow, goral and peafowl so as to allow shooting only under permits issued by the Chiefs of the States.

(2) Protecting animals during closed times similar to those in force in Burma.

It will be noticed that tsaing was not included. There are no more Chiefs. Who is now the competent authority to issue prohibitory orders under the customary laws—the Commissioner, the Special Commissioner, or the Ministers of the Shan States?

From the following extract from the Annual Report on Wild Life Preservation in the Federated Shan States for the year ending 31st March 1941, it is not clear whether the Shan States Game Rules, 1929, have since been amended:

'As the Burma Wild Life Protection Rules framed under the Burma Wild Life Protection Act, 1936, have now been issued, the question will be taken up of amending the Shan States Game Rules to accord as far as possible with the Burma Act and Rules thereunder'.

The Scheduled Areas Wild Life Protection Regulation (Regulation No. 1 of 1941) applies only to the Shan States of Hsawnghsup.

It is necessary to examine the laws at present applicable to preservation of wild life in the Shan States and extend the Wild Life Protection Act to the whole of the Shan States.

Under section 7 of the Constitution, the territories that were heretofore known as the Karenni States, viz. Kantarawaddy, Bawlake, and Kyebogyi form a constituent unit of the Union of Burma which is known as 'the Kayah State'. The position of the law is not complicated as in the Shan States. The Burma Wild Life Protection Act, 1936, can be extended straightaway and extension is recommended.

The Kaw-Thu-Lay (Karen) State was recently constituted. The Burma Wild Life Protection Act may be extended to it as in the case of the other constituent States. There should be a uniform law throughout the Union of Burma.

It is gratifying to learn that the Forest Law Amendment Committee has recommended the deletion of the proviso to section 6 and to place the burden of proof on the possessor as in the case of possession of meat of wild animals during their close season. Early legislation is necessary to remove this 'very large loophole for illicit dealings in rhinoceros blood which means dead rhinoceros.' [*JBNHS*, vol. 40 (4), pp. 594-617].

The exception is a blot on an otherwise excellent Act, but it was essential for the reason that so many people in Burma have such implicit faith in the efficacy of rhinoceros blood for medicinal purposes. Had this exception been omitted, the Bill would probably not have been passed. [See *JBNHS*, vol. 39 (3), pp. 606-608, September 1937].

THE PIDAUNG GAME SANCTUARY

The Pidaung plain was known in old Burma as one of the best localities for big game (bison, tsaing, sambar and elephant) in the Province. It used also to be famous for the herds of hog-deer that were found there. The name originated from the open stretch of country or *lwin* covered with short grass situated to the north of Pidaung railway station on the Burma State Railways. The whole stretch of country over which the game was plentiful covers a very wide area containing several *lwins* separated by hills covered with densest evergreen jungle. The first proposals came from the Commissioner of the Mandalay Division in 1908. He stated that owing to the spread of cultivation big game was rapidly decreasing and Pidaung plain was a natural haunt and sanctuary. Leading officials in Myitkyina interested in shooting were unanimously in favour of reservation. The settlement was carried out at the close of 1911. Approximately 180 sq. miles were finally notified in April 1913. The reserved area covered the stretch of country north of the railway only. In 1917 the Reserve was visited by H. E. the Lieutenant-Governor, Sir Harcourt Butler, and orders were issued for a further reservation of the area south of the railway line. This was really part of the so-called plain and contained several salt licks constantly frequented by game. The settlement was carried out in 1920, the reserve being finally notified in August 1921. The original Reserve was notified under the Burma Game Rules, 1917, as a Game Reserve in October 1918, and the south extension in 1921. Both Reserves were notified as a Game Sanctuary in September 1927. The area was then computed as 260 sq. miles. In 1937 the area was re-computed as 277.5 sq. miles. By the constitution of the Pidaung East Extension Reserve as part of the sanctuary in 1938, the area was further increased from 277.5 to 282.5 sq. miles. In order to provide a natural instead of an artificial boundary, and to free land for cultivation, an area of about four sq. miles on the west of Pidaung Sanctuary was excluded from the sanctuary in 1940. Approximately 0.736 of a sq. mile (471 acres) situated in the Kamaing Kachin Hill Tract was declared as the Pidaung West Extension Reserve and included in the Sanctuary in 1941. The present area of the sanctuary is approximately 279.7 sq. miles. During the period of Japanese occupation 4,352 acres of Pidaung Reserve and 7,129 acres of Pidaung South Extension Reserve were encroached on by Kachins from Mayan Village. This whole area is now under paddy cultivation. The harm has been done, and it seems that the Forest Department may now have to exclude this area finally.

The sanctuary was primarily constituted for the following species:—Elephant, bison, tsaing, sambar, hog-deer, barking-deer, pig, tiger, leopard, bear, peafowl, junglefowl, pheasant, partridge and quail.

There are 45 miles of paths and 57 miles of fair-weather motor road which were constructed before the war. The Stilwell Road which was constructed during the war passed through the southern sector of the sanctuary for a distance of about 7½ miles (Mile 13/4 to Mile 21/0). From Mile 17/0 of this highway, a branch road was also constructed to Hopak, a distance of about a mile. All the main salt licks and *lwins*[1] can now be reached by jeep. A special game staff of one head keeper and five assistant keepers is maintained.

Lt.-Col. R. W. Burton, I.A. (Retd.), has fully described this sanctuary in Burma (pre-1942) with present status of Rhinoceros and Thamin [*JBNHS*, 49 (4), 1950].

March 1951 - February 1952. During my tenure of office as Deputy Commissioner, Myitkyina District, I camped in the sanctuary on four occasions and spent a total of eight days. The majority of the villages just outside the boundaries of the sanctuary were also visited. I observed an elephant in Kyanan lick on one evening in March, a sambar stag in Manaw lick for several minutes one morning in May, a hog-deer stag feeding in Kason *lwin* one evening and a small herd of tsaing feeding in Pyawbwe *lwin* on the following morning in June. In the course of my wanderings I disturbed a bison on one occasion, sambar and barking-deer on several occasions; peafowl and red junglefowl were seen all over the sanctuary, Blackbreasted Kalij Pheasant (*Gennaeus lathami*) was seen once; Hoolock Gibbon (*Hylobates hoolock* Harlan), the Chindwin Langoor (*Trachypithecus pileatus shortridgei* Wroughton), the Burmese Pigtailed Macaque (*Macaca nemestrina* Linnaeus) and Phayre's Leaf-monkey (*Trachypithecus phayrei phayrei* Blyth) were also seen.

The station master, Pidaung, had seen a leopard (black variety) in the dry bed of a chaung near the railway station. In March 1932, a leopard (black variety) was shot in the sanctuary. The forest officer who sat up failed to turn up at the hour scheduled for the departure of the 'Governor's Special'. As it was feared that he had met with an accident a rescue party comprising the medical officer and the veterinary officer of the Governor's party set out fully equipped to render First Aid. To their relief the party came upon the forest officer unharmed and returning to camp with the dead leopard. The Governor's Special left Pidaung Station behind schedule. Officers from Myitkyina District who were left behind in camp found the steaks served up at dinner to be tasty, and only learnt afterwards that they were leopard meat!

Returning late from Mogaung one evening the Superintendent of Excise (U Tha Aung) noticed an animal racing alongside his jeep as he was driving along the Stilwell Road inside the sanctuary. He turned round to look and to his surprise found the animal to be a leopard.

On the 25th April 1951 at about dusk, a young cow elephant charged the up-passenger train between Mayan and Pidaung railway stations. The cow elephant received serious injuries and was destroyed the following morning.

Elephants from the sanctuary raided the standing paddy crop in Pamadi tract on two or three occasions and one of them trampled a hut in which a cultivator was keeping watch.

Two bull bison were shot inside the sanctuary, one by a Kachin from Mayan with the rifle issued for village protection, and the other also by a Kachin from Kabaw Kataung with an American rifle.

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[1] A *lwin* is an open grassy plain usually undulating and often quite a small area surrounded by forest.

The Government rifle was withdrawn and the private American rifle confiscated.

In spite of my instructions to prosecute the two culprits in the Criminal Court, the late Divisional Forest Officer closed the two cases on the report of the Range Officer that the culprits were not traceable. From the girth of the two horns, 18" in both heads, it is evident that there are still a fair number of big bulls inside the sanctuary.

Two bullocks were killed by tigers inside the sanctuary. A family of four tigers—a tiger, a tigress and two full-grown cubs—killed a number of cattle in the Pamadi tract. The Nepali headman of Pamadi shot one cub over a kill in September 1951. It is probable that the same family killed the two bullocks. One tiger was trapped by villagers from a Nepali village in January 1952 and destroyed. One leopard was also shot near Kabaw Kataung village, outside the western boundary of the sanctuary during 1951, by the Kachin who shot the second bison.

Due to shortage of salt during the Japanese occupation, villagers camped near Loipyit salt lick and boiled salt out of the saline earth. The American army set up a saw mill on a ridge close to Hopak salt lick. The converted timber was conveyed in motor lorries from the saw mill on to the main Stilwell Road. Both salt licks are now abandoned by big game. Motor vehicles passing up and down the Stilwell Road both day and night could also be heard from Hopak. There are still a few hog-deer and sambar in the area. Hopak *lwin* is admirably suited for the introduction of thamin. Saw Ze lick in this sector, Kyanan, Manaw and Maw Raw licks in the northern sector are visited by elephant, bison, tsaing, sambar and hog deer regularly.

During the war period, the Army authorities put up 'NO SHOOTING—NO FISHING' notice boards, one at Nankhwi Bridge on the old P.W.D. road from Myitkyina to Mogoung and one at Mile 13/4 on the Stilwell Road. Unfortunately this did not seem, in any way, to deter the Army personnel from wholesale shooting of game inside the sanctuary. On re-occupation, there was considerable poaching both by members of the Armed Forces and the civil population.

Poaching was rife when I arrived in the District in March 1951, but by enlisting the cooperation of the Officer Commanding, 1st Kachin Rifles, Battalion Commandant, U.M.P., headmen and elders of the villages in the neighbourhood of the sanctuary, bringing up the game staff to pre-war strength and maintaining two gates—one at Mile 11/0 and one at Mile 22/4—Mayan railway crossing on the Stilwell Road we succeeded in suppressing poaching completely by the middle of 1951. Salt was regularly put down in the salt licks and game started to appear in the many *lwins* and salt licks when I left the district in February 1952.

March 1952 - September 1953. Soon after my return from Myitkyina, the Kachin Rifles were replaced by the Kayah Rifles. The Battalion Commandant, U.M.P., a keen conservationist, was recalled to the Army. The Chief Works Officer as well as the District Superintendent of Police who cooperated whole-heartedly in my humble efforts proceeded on leave, and on the expiry of the leave returned to the Union Government.

There was also a change in the Kachin State Government. This was followed by a wave of serious crime in the Myitkyina District. Frequent poaching by parties of Army, Civil Police and Union Military Police personnel in motor cars was detected by the game staff and reports made to the Deputy Commissioner, but no action was taken to stop it. A bison was shot about half a mile from Kason Chaung Forest Rest Hut. The culprits were not apprehended. Kason Chaung is close to Nankyin village. Two assistant game keepers reside permanently in Nankyin village.

The new cantonment is now located near the sanctuary. Without the co-operation of the Officer Commanding, we will not be able to stop poaching. Game is often driven out from the sanctuary and shot outside.

October 1953-June 1954. A Divisional Forest Officer, interested in game preservation, in the person of U Maung Gale, was selected and sent to Myitkyina. Immediately on his arrival in the division in August 1953, he tried his best to effect improvements in the rehabilitation of the sanctuary. Before his work was half completed he was taken away on deputation with the Agricultural and Rural Development Corporation. Three Kachins were prosecuted for shooting a bison within the Sanctuary. The Court sentenced each of the Kachins to four months rigorous imprisonment. The headman of Nankyin village was prosecuted and fined Kyats 100 for cutting taungya inside the sanctuary. Four armed guards were added to strengthen the existing game staff of 6 game keepers. Roads were repaired so that they would be jeepable during the open season. Salt was deposited at all salt licks regularly. Poaching had almost ceased within the sanctuary. Game can now be seen in increasing numbers at the same licks. It is now left to the succeeding Divisional Forest Officers to accomplish the task of bringing back the sanctuary to its pre-war conditions.

The following statement gives a rough idea of the existing depleted stock as compared with pre-war stock. All that is done at present to estimate the stock of game is for the game establishment to prepare monthly and annual statements of game seen. These statements cannot be considered to be an accurate estimate of the actual number of the different species in the sanctuary:

Kind of Animal	Animals counted	Animals observed				
	1936–37	1948–49	1949–50	1950–51	1951–52	1952–53
Elephant	200	63	22	22	24	35
Bison	300	37	39	53	42	45
Tsaing	200	14	20	18	15	12
Hog-deer	500	4	5	5	13	32
Sambar	250	13	20	21	18	25
Barking-deer	150	3	7	5	9	8
Tiger	12	—	3	2	2	3
Leopard	10	—	—	2	2	1
Bear	20	1	—	1	3	2
Wild dog	40	1	1	2	3	4

There are two small herds of bison, one of twelve animals with two calves, and one of eight animals. The stock of tsaing consisting of a small herd of five animals is concentrated in the northern sector near Pyawbwe *lwin*. If we could completely stop burning of charcoal in the area, both bison and tsaing which have now taken to the hills might re-appear. From the report for the year ending 30th September 1953, it appears that the hog-deer from the adjoining unclassed forests have come into the sanctuary. There may be more barking-deer than the figures given in the annual statements. On my way to Nanti one afternoon I came across no less than three barking-deer. Mr. J. N. Martin the chief works officer and his wife observed a barking-deer standing by the side of the Stilwell Road. A barking-deer is also regularly seen between Mayan and Pidaung stations by passengers travelling in the up-passenger train. The figures for elephant, bison, tsaing and sambar may be considered as very nearly correct.

Namkyin Village. It is understood that the establishment of this village on the right bank of the Namkhwi Kha, was permitted by the Deputy Commissioner, Myitkyina, about the year 1932. The site falls inside the sanctuary. There are 12 households, 7 bullock carts, 9 pairs of bullocks, 4 buffaloes and 10 other head of cattle. The villagers who are all Kachins earn their living by burning wood charcoal inside the sanctuary and marketing same in Myitkyina town. It would be a problem now to shift this village.

The sanctuary is in the Kachin State and the attitude of the Kachin State Government is not known. If the sanctuary is to be rehabilitated it is essential to shift this village from inside the sanctuary.

Namse Reserve. With a view to extending the Pidaung Sanctuary to the south, settlement of 58 sq. miles of good game country to constitute the Namse Reserve was carried out in 1937 and notified in Department of Agriculture and Forests Notification No. 514 dated the 30th November 1939 with effect from the 1st February 1940.

At the time of evacuation in 1942, plans were afoot to add this reserve together with Uya-Hatha Reserve, Kawan Reserve, and all the intervening unclassed forests. This contemplated addition to the Pidaung Sanctuary was well stocked with elephant, bison, tsaing, hog-deer, sambar, barking-deer, peafowl, partridge, pheasant and white-winged wood-duck. The large open grass plains in the area make it very suitable for further development into a place where wild animals and birds can be easily seen. If this projected extension can be accomplished a sanctuary of approximately 600 square miles (including the existing Pidaung) will be brought into being.

Soon after his arrival in the Division U Maung Gale, the Divisional Forest Officer, took up the question of rehabilitation of this sanctuary and submitted proposals in May 1954. The proposals are now being examined in Rangoon and it is hoped that early orders will be issued for the settlement of the proposed extension.

The sanctuary can be developed into a National Park in a short time and it would be an asset not only to the Kachin State but also to the Union Government.

The Hon'ble Thakin Kyaw Tun, Minister for Agriculture and Forests, accompanied by U Thein, Conservator of Forests, Northern Circle, visited the sanctuary in the course of his tour in December 1953. The interest taken by the Hon'ble Minister is deeply appreciated.

TAUNGGYI GAME SANCTUARY

Year of notification	... 1st March 1930.
Area in square miles	... 6.2.
Forest division in which situated	... Southern Shan States.
Species for which the sanctuary is primarily constituted	... Birds and barking-deer.

This sanctuary was notified under the Shan States Game Rules, 1929, in Ministry of Forests Notification No. 13 dated the 22nd January 1930 with effect from the 1st March 1930. It is situated in the Shan States.

The sanctuary is more of a wild bird refuge than a game sanctuary. It was well stocked with birds and contained a few barking-deer before the War. As the sanctuary is practically surrounded by a densely populated area and is extremely accessible, poaching unquestionably takes place in spite of vigilance by the forest staff.

The Principal Forest Officer, Shan States, writes, 23rd March 1954: 'The Taunggyi Sanctuary has been greatly disturbed owing to proximity to villages and difficulty in control. There may still be about half a dozen *gyis*[1]. I gather that there are also a few leopards which prey on dogs from houses adjoining the reserve.'

KAHILU GAME SANCTUARY

Year of notification	... 1st September 1928.
Area in square miles	... 62.
Forest division in which situated	... Thaton
Species for which the sanctuary is primarily constituted	... *Dicerorhinus sumatrensis*, serow, sambar, barking-deer, mouse-deer, hog-deer and junglefowl.

This sanctuary was notified in Ministry of Forest Notification No. 188 dated the 9th July 1928 with effect from the 1st September 1928. It is situated in the Pa-an Township of the Thaton District and the Papun Township of the Salween District.

R. sondaicus was once fairly plentiful in several parts of Burma, and was realised as being in danger of becoming very rare early in the present century. But it was not until about 1927, partly as a result of the activities of Thai poachers near the Siltaing River, that the Forest Department became seriously alarmed and decided that special measures would be necessary if the species was to be saved from extinction. Unfortunately this sanctuary was established too late. A thorough investigation of this sanctuary conducted in 1938 by the late Theodore Hubback showed that at least some of the rhinoceros inhabiting it belonged to the Sumatran (two-horned) species. [*Oryx*, vol. 2 (3), pp. 145-146, November 1953].

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[1] Barking-deer.

In 1939-40, the Game Warden (F. J. Mustill) obtained definite evidence regarding the species as an excellent view and photos of a rhinoceros in its wallow were obtained at very close range. The animal was undoubtedly of the Sumatran species and its track was the largest measured in the sanctuary.

In 1940-41 the Game Warden (C. E. Milner) stated that the rare *Rhinoceros sondaicus* no longer existed here.

The Divisional Forest Officer, Thaton (August 1946) in answer to an enquiry informed Mr. W. F. H. Ansell 'that there is at least one family of rhinoceros in the Kahilu Sanctuary and that tracks of two were recently seen' [*JBNHS*, vol. 47 (2), p. 249, December 1947].

Extracts from Report on Forest Administration in Burma.

1946-47. 'Tracks of two *Rhinoceros sumatrensis* were reported seen in the sanctuary'.

1947-48. 'A *Rhinoceros sumatrensis* was reported seen occasionally'. Information later than 1948 is not available. The sanctuary is situated in the area at present under occupation by the insurgents (Karens).

Besides *Dicerorhinus sumatrensis* the sanctuary contains serow, hog-deer, mouse-deer, barking-deer and a few bison. This sanctuary falls within the recently constituted Kaw-thu-lay (Karen) Stae.

MULAYIT GAME SANCTUARY

Year of notification	... 1st January 1936.
Area in sq. miles	... 53.51.
Forest division in which situated	... Thaungyin.
Species for which the sanctuary is primarily constituted	... Barking-deer, pig, tiger, and leopard.

This sanctuary was notified in Ministry of Forest Notification No. 232 dated the 5th November 1935 with effect from the 1st January 1936. It is situated in the Kya-in Township, Kawkareik Sub-division, Amherst District, on the western slopes of the Dawna Range and takes its name from the highest point in the area, namely Mount Mulayit (6,823 ft.). Mount Mulayit is a place of pilgrimage and the slopes of the mountains are uninhabited and likely to remain so.

This is the first of a series of sanctuaries constituted with the support of the Buddhist monks. In an area with such great range in elevation (6,823 ft. down to 1,200 ft.) the flora varies a great deal—from dense evergreen and moist deciduous forests to hill forest and open grass screes on the highest slopes. There is therefore much variety of food for herbivorous fauna. The streams are all perennial and there are plenty of fish in the deep pools which occur. The climate is wet with a rainfall of probably more than 200 inches *per annum*. This sanctuary was originally thought to contain rhinoceros, but so far their presence has not been either proved or disproved. Tracks of a rhinoceros believed to be *R. sondaicus* were seen on the Dawna Range at 6,822 ft. (1929-30). The probability is that specimens may wander there from time to time. The sanctuary was last visited in 1946-47 by the range officer who found tracks of bison, mouse-deer, sambar, barking-deer, pig, bear, tiger and leopard.

A detailed faunal and floral survey is necessary. The area is at present under occupation by insurgents (Karens and Mons), and falls within the newly constituted Karen State.

SHWE-U-DAUNG

Year of notification	... 1918.	
Area in square miles	... 126.	
Forest division in which situated	... Katha East, Burma.	81
	Mong Mit, Shan State.	45
		126
Species for which the sanctuary is primarily constituted	... *Dicerorhinus sumatrensis*, elephant, bison, tsaing, sambar, serow, barking-deer, pig, tiger, leopard, bear, peafowl, junglefowl, pheasant, partridge, and quail.	

81 sq. miles of the Shwe-U-Daung Reserve lying in the Mogok and Thabeikkyin Sub-Divisions of the Katha District was originally notified as a Game Reserve in 1918 and declared as 'The Shwe-U-Daung Game Sanctuary' in Forest Department (Ministry of Forests) Notification No. 243 dated the 29th September 1927. 45 sq. miles of the Shwe-U-Daung Reserve lying in the Mongmit State was declared as 'The Shwe-U-Daung Game Sanctuary, in Forest Department—Notification No. 138 dated the 22nd July 1929 with effect from the 1st August 1929. An account of this sanctuary by E. H. Peacock has previously been published in 1931 [*JBNHS*, vol. 35 (2), October 1931].

The sanctuary contains all species of animals indigenous to Northern Burma with the exception of thamin, goral and hog-deer and many of these can be observed on the open grassy hill slopes found at high elevations within the sanctuary. The scenic value of the sanctuary is said to be almost unequalled within the Union, many of the hills within it being over 5,000 ft. above sea level. The Shwe-U-Daung Hill from which the sanctuary takes its name rises to an altitude of 6,222 ft.

In 1939, this sanctuary was visited by the Conservator of Forest, Northern Circle, the Game Warden and the Divisional Forest Officer, Mong Mit Division. It was then estimated that the sanctuary contained from twelve to fifteen specimens of *Dicerorhinus sumatrensis*. Sambar could be seen at any time of the day on the open grassy slopes, which are the most distinctive features of this sanctuary. Elephants are extremely plentiful. In 1940, no casualties among the *D. sumatrensis* were reported. The Game Warden (Mr. Mustill), who visited the sanctuary during the year, was struck by the diminution in numbers of sambar which live almost permanently in the open grass country along the higher ridges. Elephants abound in the sanctuary.

The higher slopes were inhabited by several species of pheasants. The Game Warden was able to identify the Burmese Barbacked Pheasant. The Arakan Hill Partridge was also identified. Since then, the sanctuary was last visited by the Divisional Forest Officer, Mong Nit Division (E. A. P. Reynolds), in April 1948. He did not see any *D. sumatrensis*, but saw fresh tracks of one and a month-old spoor of a cow with a calf at heel. The Range Officer, who visited the sanctuary in May 1948, saw a *D. sumatrensis* in a mud wallow.

The Range Officer found old poaching camps in the Tonkha drainage (Mong Mit Sector) dating from Japanese days. There was definite indication also that poaching had been going on from the Burma side. After sifting available evidence, the Divisional Forest Officer concluded that despite poaching there were approximately 4 to 5 specimens of this rare animal surviving in the Mong Mit Sector of the sanctuary.

The Divisional Forest Officer counted thirty sambar feeding on the grassy hillocks and knolls of Namadawgyi between 4,500 and 5,000 ft. contours one morning. A forester of the party while clearing paths saw three tigers, two Himalayan bears, a herd of elephants and a small herd of bison.

There is a local legend that the best time to come across rhinoceros is during the full moon of Waso (July) when they usually congregate together.

1949-50: Due to very insecure conditions prevailing in the immediate vicinity of the sanctuary, the Divisional Forest Officer was unable to visit the sanctuary. The terrain affords an ideal hiding ground for poachers, and fears were entertained that some of the animals in the sanctuary had been disturbed.

1950-51 and 1951-52: Nothing of importance was reported. But the writer was informed by a gazetted officer of very senior rank that three rhinos had been shot inside the sanctuary—one under a special permit issued to the Maha Devi of Mong Mit for medicinal purpose, and two illicitly by the Shan hunters who were entrusted with shooting the first. The circumstances which led to the issue of the special permit were:—

(1) A physician prescribed the Maha Devi to take rhino blood bath.

(2) A male *D. sumatrensis* was shot inside the sanctuary by Game Warden (E. H. Peacock) in October 1930 under the direction of the then Local Government for museum purposes.

Present-day conditions are quite different. The Game Warden (E. H. Peacock) writes in February 1951:

'The destruction of this animal is less to be deplored than might be apparent, as there are fully ten other rhinoceros living in the sanctuary under conditions ideal for their continued existence and increase.'

The few surviving specimens are constantly harassed by poachers. The sanctuary is often disturbed by the presence of insurgents inside its boundaries.

The legend that the mountain spirits of Shwe-U-Daung do not like poachers is no longer heeded by the people resident in the neighbourhood of the sanctuary.

East Katha Sector (Burma).

1949-50. The Divisional Forest Officer, writes:—

'Owing to continued lawlessness in the Thabeitkyin Range, it was also not possible this year for the writer to carry out a survey of the game in this sanctuary. Tracks of rhino were rarely seen according to the report from the Range Officer, Thabeitkyin. As no poaching could be prevented under existing conditions of lawlessness, the number of rhino present will not be more than a couple if any exist at all in the sanctuary.'

1950-51: Not possible for any gazetted forest officer to visit the sanctuary. The Range Officer, Thabeitkyin, reported one male, one female and one calf rhino as existing in the sanctuary.

1952-53: Owing to the presence of insurgents in the area, it has not yet been possible for the Divisional Forest Officer to visit the sanctuary. From enquiries conducted by the Range Officer, Thatbeitkyin, it is learnt that three rhino (one male, one female and one calf) are surviving in the thick jungles in the upper reaches of Shwe-Hyar Chau g.

'It will be necessary in the interest of game to post a Deputy Ranger and two foresters to the Sagadaung beat in the near future for effective patrolling of the Game Sanctuary—at present there is only one forester.' [Annual Report on Forest Administration, Mong Mit Division (1947-48)].

No action appears to have been taken on the above recommendation.

Two trial lines for finding the best route to the upper slopes of Shwe-U-Daung were cut in 1938. The routes may be re-surveyed when local conditions permit.

KYATTHIN WILD LIFE SANCTUARY

Year of notification	... 1941.
Area in square miles	... 104.
Forest division in which situated	... Shwebo.
Species for which the sanctuary is primarily constituted	... Thamin.
Establishment	... One game keeper.

This sanctuary was notified in Department of Agriculture and Forests Notification No. 177 dated the 19th June 1941 with effect from the 1st September 1941. It is situated partly in the Kawlin Township of Katha District and partly in the Kanbalu Township of Shwebo District. It was primarily constituted for thamin. Its constitution is a departure from all existing ideas concerning sanctuaries in that, for the first time, villages are included inside the sanctuary. Co-operation of the villagers is to be enlisted by offering to pay compensation for damage to their crops by the wild animals. The suggestion made at the time of the constitution is that compensation would take the form of paying the Land Revenue for the villagers in return for which the villagers would be asked to co-operate in preserving the fauna in the sanctuary.

Apparently this new idea has been overlooked by Forest Officers concerned. The Conservator of Forests, Northern Circle, has not made any comment on this new idea in any of his annual reports (1945-46 to 1950-51).

This sanctuary includes an area of swamp which will form an excellent bird sanctuary. The whitewinged wood-duck and whistling teal breed in the area whilst there are many other species of water fowl, which live here permanently. In 1937, the area proposed for constitution as a sanctuary was estimated to contain 150 head of thamin. In 1945-46 the Conservator of Forests, Northern Circle, reported that the number of thamin had been reduced to one-third of the pre-war number. This would mean that there were about fifty thamin in 1945-46.

The number increased to eighty in 1948-49 and to one hundred and fifty in 1951-52. This sanctuary is situated in Thaw Range. The number of thamin in Thaw Range was estimated as 600 to 700 in 1952. Many animals from the unclassed forests had apparently taken up residence inside the sanctuary.

Tsaing and barking-deer are also reported. When proposals for constitution of this sanctuary were submitted in 1937 there was a herd of about fourteen tsaing in the area.

Note. The land occupied by the Burma Railways, Kyatthin-Yindaik Fuel siding where the siding passes through the Kyatthin Fuel Reserve and Kyatthin Extension Fuel Reserve, is included in the sanctuary boundaries as notified in Notification No. 177 dated the 19th June 1941.

SHWEZETTAW WILD LIFE SANCTUARY

Year of notification	... 1940.
Area in square miles	... 213.4.
Forest division in which situated	... Minbu.
Species for which the sanctuary is primarily constituted.	... Bison, sambar, thamin, and barking-deer.

This sanctuary which is situated in the townships of Sidoktaya, Pwinbyu, Sagu and Ngape of the Minbu District was notified as a wild life sanctuary in Department of Agriculture and Forests Notification No. 210 dated the 29th June 1940 with effect from the 1st September 1940. The sanctuary is within two hours' motor drive from Minbu and takes its name from the famous Shwezettaw Pagoda, a place of pilgrimage for Buddhists. This sanctuary and Kyatthin Wild Life Sanctuary in the Shwebo Forest Division were constituted primarily for the perpetuation of Thamin (*Panolia eldi thamin* Thomas) the deer typical of Burma. When proposals for constitution of this sanctuary were submitted in 1937 there were at least 100 head of thamin, some 40 head of bison and a few tsaing in the area. Thamin were reported to be on the increase and in 1946-47 and 1947-48, their number in the sanctuary was estimated at one time to be 350. The whole of Minbu District was, however, overrun by insurgents in 1948-49. Though Minbu and the riverine towns have since been re-occupied and are under civil administration of the Union Government, the forest area including this sanctuary is still occupied by underground communists. The Divisional Forest Officer (U Ba Thaung) reported on 23 November 1948:

'Up till now thamin, though in reduced quantity, continue to exist and are found sparingly and sporadically. Quite a number have evacuated into the adjoining scrub jungles. Everywhere they are now seen in panic, and run away at a distance. No poacher will find it easy to bag them. It is believed that when the population has been harnessed and law and order has been restored thamin will return to their original homeland, and large herds of them will reappear again majestically.'

To my query the Divisional Forest Officer (U Aung Myint) replied in September 1953:

'I think the number of thamin in Shwezettaw Wild Life Sanctuary is on the decrease due to heavy poaching during the Japanese occupation. Poaching is still going on during these days of insurrection as the area is still unoccupied by Government forces.'

MAYMYO GAME SANCTUARY

Year of Notification	...	1918.
Area in sq. miles	...	39.91.
Forest Division in which situated	...	Maymyo.
Species for which the sanctuary is primarily constituted	...	Barking-deer, junglefowl, partridge, and peafowl.

Originally notified as a Game Reserve in August 1918 for the benefit of the public of Maymyo, this sanctuary was re-notified as 'Maymyo Game Sanctuary' in Ministry of Forests Notification No. 243 dated the 29th September 1927. The present boundaries of the sanctuary were revised with effect from the 1st November 1928, *vide* Notification No. 240 dated 17th September 1928. Prior to its constitution all wild life was rapidly being exterminated in and around the station, and it was to enable residents to see a certain amount of bird and animal life that the sanctuary was formed. As a result of 35 years of protection, the original stock of junglefowl and barking-deer had increased considerably and there was an excellent stock when the War broke out.

'During the Japanese regime, villages around and inside the sanctuary expanded with the influx of refugees, and to cope with the shortage of food, *taungya* cultivation was carried out inside reserved forests without any restriction and though it was brought under control later, the lands already cleared and cultivated are no more suitable to be retained as reserved forests. Now, as there is genuine land hunger and as the disforestation of affected parts of the reserve is recommended by the Deputy Commissioner, Mandalay, action is being taken for dis-forestation, and as such the area of the sanctuary will be reduced by about 5,900 acres, curtailing the area available for occupation by wild life.

'The situation of the sanctuary close to a popular hill-station like Maymyo—serves as a life-museum and could develop into a popular 'National Park' if steps are taken to educate the public in the appreciation of wild life. But so far, the sanctuary has suffered from uncontrolled hunting by the people and the military personnel during the whole period of Japanese occupation, and the initial stages of British reoccupation[1].

'Since the beginning of 1947, steps are taken to enforce the game rules and appeal made to military personnel is proving successful. Besides, the unsafe condition for any one to hunt in the sanctuary due to the activities of insurgents in 1948 kept the game reserve in the vicinity of Maymyo undisturbed throughout the year. Barking-deer exist in fair numbers, tiger, leopard, wild dog and wild cat are to be found in the sanctuary, and tracks are reported to have been seen in compartment 24, near Singaunggale, Phoungdaw and Ye-gyon-oh villages. Junglefowl is distributed throughout the sanctuary, and peafowl can be seen near Nyaungni and Ye-gyan-oh villages during winter.' (Divisional Forest Officer, Maymyo. 10th January 1949).

'The appeal to the Military authorities for co-operation was repeated in May 1952. Tigers and leopards are much in prominence and occasionally lift dogs and goats from inside Maymyo Town.' (Annual Report 1952-53).

'In 1954 a leopard walked one morning into a bungalow in Maymyo while the owner was having his morning coffee, and was trapped inside and shot by a police officer who was called in.

MOSCOS ISLAND GAME SANCTUARY

Year of notification	... 1924.
Forest division in which situated.	... Tavoy.
Area in square miles	... 19.
Species for which the sanctuary is primarily constituted	... Sambar, barking-deer, and pig.

Originally notified as a Game Reserve in 1924 and declared as 'Moscos Island Game Sanctuary' in Forest Department (Ministry of Forests) Notification No. 243 dated the 29th September 1927.

It was hoped to be able to stock the islands with species which might ultimately become exposed to extermination on the mainland. With this object in view nine sambar, three barking-deer (all stages), four hog-deer, nine pigs and two junglefowl were released from time to time between 1924-1929. The Divisional Forest Officer, Tavoy Division, who visited the sanctuary in 1937 doubted whether any of the hog-deer or barking-deer, had survived. He suggested 'that the island is well suited for development into a seaside resort for Rangoon, being only a few hours' journey by sea-plane. Excellent sea bathing and sea fishing offer great attraction, and if such development takes place the establishment of a well-conducted wild life sanctuary on the islands would prove an additional asset.'

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[1] On British re-entry administrative instructions were issued that the Forest and Game Laws were not to be enforced too strictly in consideration of the bad time the population had been through in the war years. In areas where touring is now possible, it is found that much game is destroyed by peace guerillas, who misuse the ammunition issued by Government for local defence.

A pair of barking-deer and a young sambar (stag) were released in 1938 and 1939 respectively.

The Game Warden (H. A. Maxwell) who visited the sanctuary (1938-39) wrote:

'Of the indigenous fauna, the crab-eating monkeys are well represented. Hornbill and Imperial pigeons are also numerous, while there is a great variety of bird life, the study of which would require a prolonged stay on the islands.'

The Game Warden (F. J. Mustill) wrote (1939-40): 'Unless these islands are stocked with animals and birds imported from the mainland, there is little point in maintaining a sanctuary here.'

Of the animals released only the pig is established on the islands. Nine sambar and about 500 pigs were reported by fishermen in 1950-51.

The evergreen forests on the islands afford poor feeding, and clearings are required to provide suitable feeding grounds for any animals imported.

As the area is a notified sanctuary, all interference with wild life is prohibited. But collection of edible birds' nests and turtles' eggs is authorised. The Union Government may not be prepared to forego the revenue. The collection of edible birds' nests should at least be restricted. This is necessary for the preservation of the Grey-rumped Swifts (*Collocalia francica*) which are responsible for these nests.

The Deputy Commissioner, Tavoy, (U Kyaw Thant) who was consulted writes on 6th April 1954:

'I discussed it with the Divisional Forest Officer and since no Forest Officer had visited it during the past years because of the insurrection nobody knows the present position of the sanctuary. The island proves to be poor feeding ground, and it is very doubtful if it will become a seaside resort at all, because of the easier accessibility of Maungmagan beach. Maungmagan is only ten miles from Tavoy by motor car and there is very little danger of its becoming overcrowded. The Moscos, on the other hand is about 20 miles from Tavoy, and the communication is very poor and by fishing boats.

The right to collect turtle eggs during 1953-54 was sold for Kyats 150 and the right to collect edible birds' nests for three years 1951-54 for Kyats 141,000.

Pre-war the licensee paid Rs. 450 per annum for the right to collect the turtle eggs and sold them on the mainland at from two to three annas for ten.

WELTIGAN WILD LIFE SANCTUARY

Year of notification ...	... 1st September 1939.
Area in sq. miles	... 1.70.
Forest division in which situated	... Minbu.
Species for which the sanctuary is primarily constituted	... Many species of waterfowl.

This sanctuary which is situated in the Salin Township of the Minbu District was notified as 'Weltigan Wild Life Sanctuary' in Department of Agriculture and Forests Notification No. 275 dated the 5th July

1939 with effect from the 1st September 1939. The sanctuary consists mainly of lake and marsh land. At the time of constitution there were 33 resident bird species and 31 migrant species. The suggestion that the area be notified as a reserve emanated from Kan Kyaung Sayadaw, the head of the monastery situated on the shores of the lake. The Sayadaw was strongly supported by the headmen of Hgalinban, Sin-Kyon, Tamagyaung, Anauk-kanbaung and Shanzu village tracts. During the period of Japanese occupation, there was considerable poaching not only of the waterfowl but also of the fish.

The Divisional Forest Officer (U Ba Thaung) reported in November 1948: 'The sanctuary is now reviving and the stock is on considerable increase, and at present it is in its early stage of rehabilitation. The advantage of its proximity to Salin, the Headquarters of the Civil Sub-Division, and also that of the Salin Forest Range, and co-operation of many good citizens with sense of civic duties help towards its success which appears to me to be promising'.

But I learnt from the present Divisional Forest Officer (U Aung Myint) in October 1953, that the water in the lake is very low. He attributes the cause to the wholesale cutting down of cutch trees in the insurgent occupied areas by villagers under permits issued by the insurgents. A senior forest officer with whom I discussed considers that on-the-spot investigation would be necessary to ascertain the actual cause, as the water in Maymyo Lake is also very low. There the cause is attributed to cracks in the earth surface caused by bombing during the war.

Rights and privileges granted as below:

Particulars of holders.		*Particulars of rights and privileges*
Owners of cultivation ...		To scare wild birds which are destroying crops but the use of fire-arms, catapults or any injurious weapon is not permitted.
The public ...	*(a)*	To graze and water cattle without restriction.
	(b)	To collect lotus leaves, fruits and grass without restriction.

KELATHA HILL WILD LIFE SANCTUARY

Year of notification	... 1942.
Area in sq. miles	... 9.45.
Forest division in which situated	... Kado and Agency.
Species for which the sanctuary is primarily constituted	... Junglefowl and numerous species of birds.

This sanctuary was notified in Department of Agriculture and Forests Notification No. 9 dated the 12th January 1942 with effect from the 1st April 1942. The proposal for its constitution emanated from the leading monk of Kyaungtaya—Myathabeik monastery situated in the Kelatha Range of hills.

Besides junglefowl and numerous species of birds, barking-deer and serow are also benefited by the constitution of this sanctuary.

The sanctuary lies within the Kado and Agency Forest Division in the Bilin Township of the Thaton District but is placed under Thaton Forest Division for administrative convenience. At present it falls within the area occupied by the KNDO and KMT.

UNOFFICIAL GAME RESERVES

In the Southern Shan States there are eight unofficial game reserves in areas outside forest departmental control. Five reserves are situated in Yawnghwe State, two in Lauksawk State, and one in Kengtung States.

They were maintained by the Chiefs in the interests of wild life protection. All these reserves are frequented by large numbers of duck and waterfowl which together with the fish are protected by the Chiefs under the customary law. With the recent change in the administration of the Shan States, how these unofficial reserves will fare in the future is not known.

The Principal Forest Officer, Shan States, would alone be able to advise the Shan States Government as well as the Union Government. These reserves should be perpetuated and not allowed to lapse.

PROPOSALS FOR NEW SANCTUARIES

(1) In 1939-40, the villagers living round the Htu Lake situated two miles south of Inbin village, Myanaung Township, Henzada District, requested that the lake which covers some 5 sq. miles may be formed into a sanctuary.

Preliminary notification was issued in the Department of Agriculture and Forests, Forest 11 Branch Notification No. 37 dated February 4, 1942. Its approximate area is 5.63 sq. miles.

With the present improved conditions in the area, the Divisional Forest Officer, Henzada-Bassein Division, may be appointed to be settlement officer in place of the Game Warden to fulfil the long outstanding request of the villagers.

(2) Proposals for formation of a wild life sanctuary in the Hlaing Yoma Hills Reserve of Insein Forest Division, comprising the Hlaing Yoma Hills, Wanetchaung and Kalitaw Reserves embracing the catchment area of the Rangoon water supply dam at Gyobyu, were under consideration at the time of evacuation. It is felt that such an area which can easily be reached by car from Rangoon will, if developed, provide a very welcome source of recreation to the citizens of Rangoon.

(3) Notification proposing the Byingye Hill as a sanctuary in the interests of goral was issued in 1941. The area selected is situated partly within the Byingye Reserves of Yamethin Forest Division and partly in the Shan States and covers approximately 12 sq. miles. The goral is practically limited to the three peaks of Byingye (6,254 ft.), Megon, (6,169 ft.) and Tinyudaung (5,959 ft.).

The constitution of this sanctuary would save the remaining accessible heads of goral in the Union from extermination. It is hoped that settlement of this sanctuary would be taken up as soon as the situation in the area returns to normal.

(4) In 1936, the Divisional Forest Officer, Arakan Division (Mr. Castens) suggested the Kyaukpandaung Hill as a suitable area for a sanctuary. He remarked as follows:—

'From many points of view this hill is a most attractive proposition as a Game Reserve. Though at present inaccessible it could be connected to Paletwa by a fair weather motor road with only one difficult stretch, that from Amataung to Tawseik Sakan. This would bring it within two days' journey of Akyab and a minimum of three days from Rangoon or Calcutta.

'The hill forms a horseshoe-shaped plateau, the inner and outer rims of which are precipices. The plateau is covered with a type of hill evergreen with a number of *lwins* along the outer (and higher) edge. A herd of bison is said to live permanently in the forest of the plateau and certainly at times grazes in the *lwins*. Strangely enough, no sambar have ever been seen on the plateau, while elephants, though common on the lower slopes, do not often reach the top.

'The greatest attraction of the plateau, however, lies in the unrivalled opportunities it offers for the observation at close quarters of serow and more particularly goral. These animals graze freely on the open slopes below the outer precipice and can be watched for hours from the top. During my short stay I saw one serow and six goral grazing in the open, while other members of my camp watched a herd of about ten goral for a period of about two hours from a distance of about 40 yards.

'The scenery on the plateau is the most magnificent I have seen anywhere in Burma. Shooting serow and goral is limited to those slopes which can be reached by descent of the cliffs, which is possible only in one or two places. There is a limited amount of native poaching of serow, goral and bison.'

Apparently the above proposal has not been lost sight of, judging from the following remarks in the Annual Report on Forest Administration for the year ending September 30, 1946:

'A possible sanctuary for the protection of goral was previously suggested in Kyaukpandaung Hills, east of Paletwa in the Arakan Division. This area is very remote and protection will have to be left mainly to the subordinate staff.'

The proposed area falls within Chin Hills Special Division to which the Wild Life Protection Act, 1936, was extended in 1948. As remarked by the then Game Warden (F. J. Mustill), an area which affords opportunity of observing serow and goral at close quarters is certainly worth consideration. Byingye Hill sanctuary alone would not be sufficient for the perpetuation of goral. Settlement can also be carried out now.

The Chief Conservator of Forests as a member of the Chin Hills Development Committee, has undertaken along with the committee three fact-finding tours of the Chin Hills Special Division. It is therefore presumed that he has examined this proposal on the spot. The Chins are a law-abiding people. They are not likely to contravene the game rules when the area has been notified as a wild life sanctuary.

ABORIGINAL METHODS EMPLOYED IN KILLING AND CAPTURING GAME

BY

K. M. KIRKPATRICK

(*With six text figures*)

Before the introduction of the fire-arm, the aboriginals were hunting in the forests of India. Their whole life being devoted to the filling of the family stomachs, it is not surprising that they invented methods of killing and catching game to supplement the efforts made with their bows and arrows, axes, and—sometimes—spears. The aboriginal kills for two reasons. The primary reason is food, for as the Ho say 'merim he merim' (meat is meat), and they are not particular as to whether this meat is furred, feathered or scaled as long as it is edible. The other reason for killing is when animals prove themselves to be a menace to the security of the aboriginal. No aboriginal kills for the sake of killing, and they can see no object in destroying an animal for the sake of sport or for its hide, head or horns. They kill, primarily, for food and food alone, much as any other carnivore, and were, before the influx of outside hunters, an important feature in the scale of the balance of nature.

The aboriginals with whom I am familiar, having lived amongst them in their villages, are the Ho, the Munda, the Urang and the Bhuiya of south Bihar and the States of Gangpur and Bonai, the Kutia Khond and the semi-hindu Oriya of Kalahandi and Jeypore Samasthanam, the Muria of Bastar and the wandering almost pigmy Bir-ho of south Bihar and northern Orissa. Their traps are described here as well as their methods of securing game. In order to attain some sequence, I am listing the animals and birds concerned, grouping several species where the trap is common, in order of classification.

MAMMALS

THE COMMON LANGUR (*Semnopithecus entellus*)

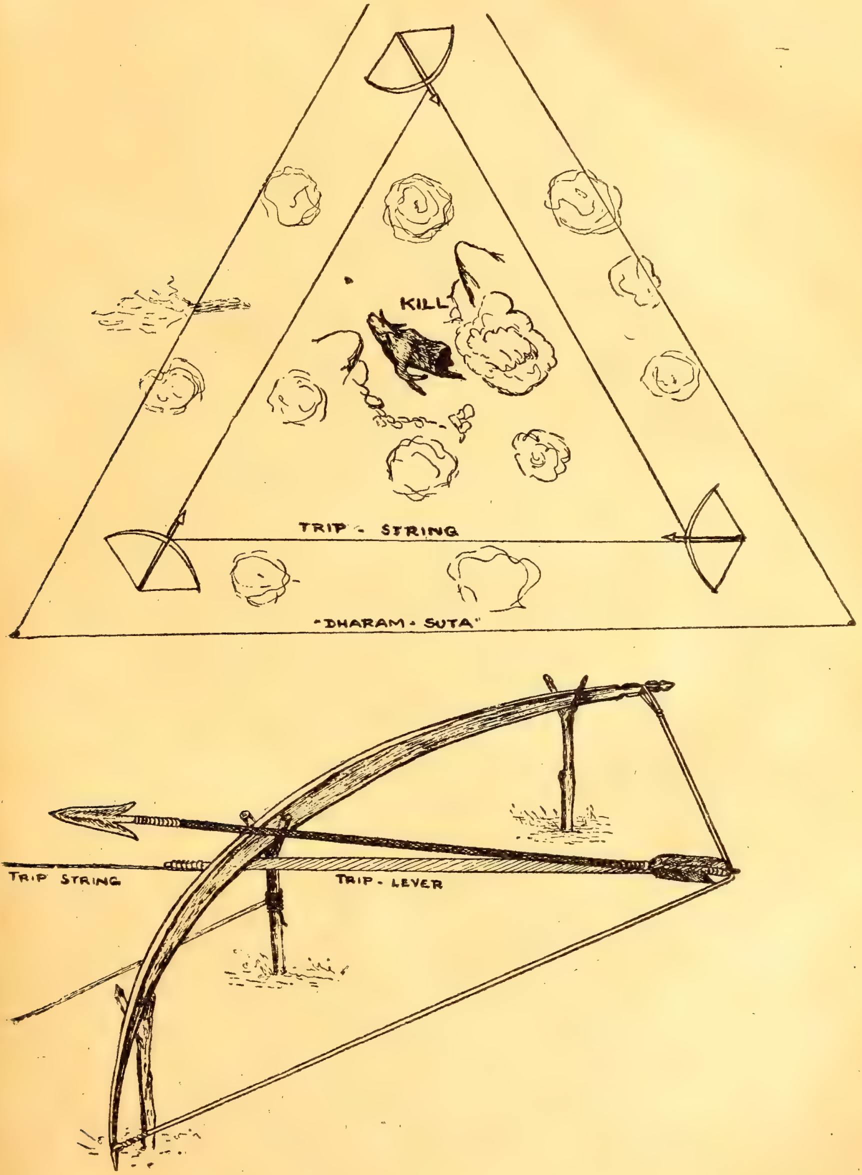
Amongst the forested hills of south Bihar and northern Orissa wander the small family parties of the Bir-ho ('Bir' meaning forest and 'Ho' meaning man), a jungle people of no fixed abode to whom the jungle is home and in which they live and die, erecting little shelters of branches or of grass as temporary shelters when the weather is wet or cold. They live on the forest life around them and their major source of sustenance is the Langur or Entellus monkey. In the tall tree forest, the langur very seldom comes to the ground but lives the major part of its life amongst the high branches. Up there in that leafy world, it has its special sleeping sites, its chosen food sites, and to and fro between these it has its well-marked travel routes, running along the same branch and jumping from the same springy take-off point to leap across and land on the same landing point. The Bir-ho is well acquainted with the fact that these monkey-gangs tread the same familiar path to and from their sleeping places and, on moving into a section of forest, they immediately scout out the Langurs' routes, the times at which they are used, and the frequency with which the gangs travel over them. Having gleaned this information, the route is reconnoitred and a spot, usually where the monkeys leap across some gap and are bunched together on some branch, is chosen.

One of the hunters climbs up the tree at a time when the monkeys are furthest away from the scene and very carefully cuts through the underside of this selected branch until it is literally hanging by a thread and will be disturbed by the slightest weight. Nets woven of the bauhinia creeper are slung loosely bag-like beneath the branch and the aboriginals settle down to await the monkey-gang's arrival.

As soon as the monkeys are near, one or two small boys create an uproar behind them, causing the monkeys to run for safety and this they do, leaping across the gap bunched closer together than normal on to the weakened branch, which gives beneath their weight so that some fall into the bag-nets, others lose their balance or jump wildly elsewhere on seeing the trap their leaders have fallen into, whilst the little Bir-ho shoot at them with their arrows; their shooting is fairly accurate and I have often seen an entellus shot in mid-air. The netted monkeys are not killed until later and it is usual to kill all the adults caught but to keep the young as pets—(for consumption at some later date when food is hard to find?)

THE TIGER (*Panthera tigris*)

The tiger constitutes a grave threat to the aboriginal, especially in those areas where encroaching civilisation has caused a depletion in the deer population of the forests. In such areas the tiger falls back on the killing of cattle, and sometimes human beings, and it is usually the forest dweller who suffers. Thus, during the breeding season, in Saranda, I have known a pair of tigers kill three cattle of Baliba village on one night, two cattle of Ponga village the next, and finally five cattle near Chota Nagra village on the third night—all these villages are roughly eight to ten miles from each other in a triangle. In such cases and where a tiger is making a nuisance of itself by preying on village cattle or on human beings, the villagers usually call for the services of a professional tiger-killer or 'Bagh-mari'. This gentleman contracts to dispose of the tiger for a consideration in cash or kind. His equipment consists of three large bows, capable of propelling arrows some five to six feet in length carrying barbed heads of iron some nine to ten inches long. These bows are set in a triangle around the kill, the lane of fire of each bow being cleared, and each bow is then set for firing with a trip-string. The bows are so aligned that the arrow, which travels with considerable velocity on release, will fly about twenty inches above the level of the ground. Some ten paces back from these trip-strings, the tiger-killer strings a 'Dharam-suta' (a life-saving thread) at chest height from the ground. This latter string serves to warn any human intruder that the trap is set. The tiger, of course, passes below this string on its way to the kill and usually fouls one of the trip-strings, whereupon the arrow is released and the tiger mortally wounded or killed outright. There have been instances where man-eaters, who have become gun-shy and who will not return to the kill after making the first meal from it, have been secured by the tiger-killer using himself as bait by sitting in the centre of his deadly triangle. Thus, in 1949, the Patharbasa man-eater in Saranda R.F. was disposed of, the fee being Rs. 300. Sketch no. 1 illustrates this type of trap.



Sketch 1.—Tiger Trap.

Another trap, not known to the Ho, Munda, Urang (or ? Oraon), Kutia Khond or Bhuiya, is the 'Suri-phanda' used in Central India. This consists of tying the kill to a barked and slippery pole, which is lashed horizontally between two stout trees at some twelve feet above the ground. The ground below the kill slung on this pole is planted with upright spears, concealed as best possible in the grass or bushes. The tiger, on approach, sees the kill dangling out of reach and tries to secure it by climbing one of the support trees and then out along the pole, which, being both slippery and too narrow in diameter to afford a grip for the great paws, causes the tiger to miss its step, slip and fall on to the waiting spears below, its heavy weight usually inflicting a mortal wound.[1]

Other methods, which I have not observed personally, but about which I have been told by the people of Erpund pargana, Bastar, are as follows:—

(*a*) A path frequently used by the tiger is carpeted with large Bauhinia leaves or Asan leaves, liberally smeared with bird-lime, made from pipal tree latex and mustard-oil. The tiger, walking on the path, puts his foot on a leaf, which promptly adheres to it; he struggles to shake it off and usually collects a few more leaves on his other feet and legs. He then tries to lick the leaves off and these adhere to his head until, finally, he succumbs to a terrible rage and rolls, roaring loudly, on the leaves. The waiting hunter, secure in some retreat, hears the roars, walks up and shoots the tiger with an arrow from a safe distance.

(*b*) Large, loosely hung nets constructed of Bauhinia creeper are slung on weakly planted bamboo poles across several paths used by the tiger around his favourite lying-up haunt. Two hunters are stationed near each net whilst beaters enter the area and make a tremendous uproar by beating drums, whacking bushes and shouting very loudly. The upshot of this is that the tiger decides to leave the area in a hurry and runs into one of the nets, the weak bamboos collapse and the net enmeshes the struggling tiger, which is then disposed of by the sentries. I have seen these nets, which are also used in securing deer, but I have never witnessed a hunt in action.

THE LEOPARD, OR PANTHER (*Panthera pardus*)

The panther probably constitutes the greatest menace or nuisance to the aboriginal. Virtually every village in or near the forest is haunted by one or more of these beasts, which prey on cattle, goats and dogs and sometimes become man-eaters. Their great cunning combined with their familiarity with man makes them all the more dangerous, and the aboriginal is only too glad to dispose of them but usually does not do so until they have become an extreme nuisance. The south Bihar-northern Orissa tribes usually employ a bow-trap, illustrated in sketch no. 2, which is fairly satisfactory. A bow is tied to two small 'Y' stakes facing the narrowly opened gate in a fence, through which the panther has been observed to move. Another 'Y' stake is planted in front of the bow and this supports a piece of bamboo, one end of which is rounded and holds the bow string back, a small notch in this bamboo holds against the supporting 'Y' stake's fork when the pressure of the bow-string forces it forward. From the other end of the bamboo, a short string holds up one end of a small plank, which is placed directly in the open gate-way. The whole trap is set with great care and the bamboo is virtually a hair-trigger for the slightest pressure on the plank causes the bamboo to jump up and release the bow string, propelling the arrow forward with great velocity. The bow is so set that the arrow flies diagonally upwards. The marauding panther usually tries to sneak through the gate, treads on the plank and releases the arrow, which strikes it in the chest or head inflicting a terrible wound or killing the animal completely. This trap is very common amongst the Urang.

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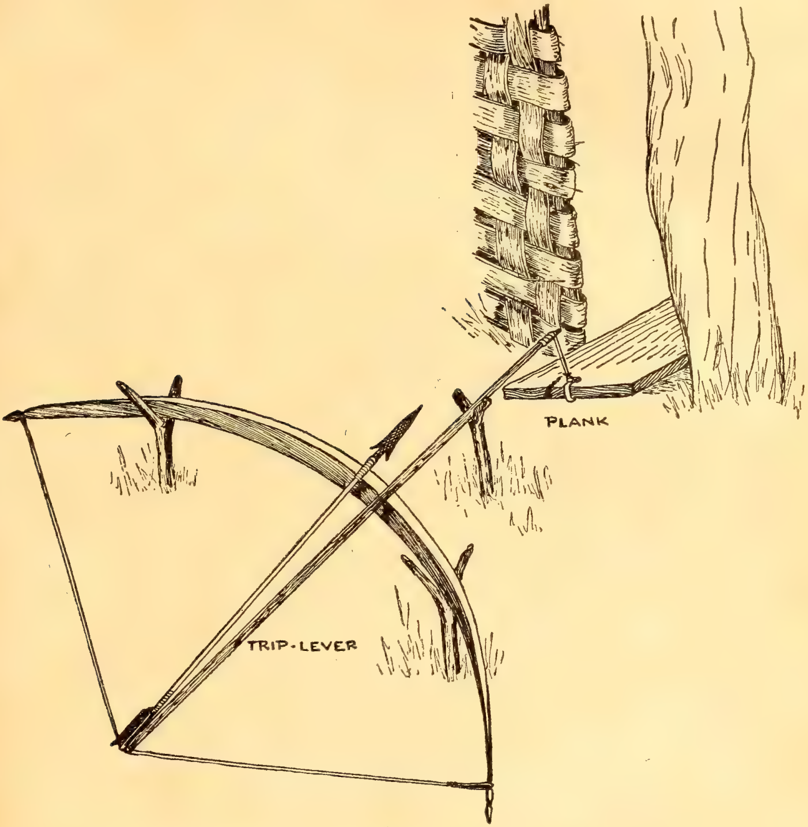
[1] For further details of this method, see Davar, *JBNHS*, Vol. 49, p. 52.—EDS.



SKETCH 2.—Panther Trap.

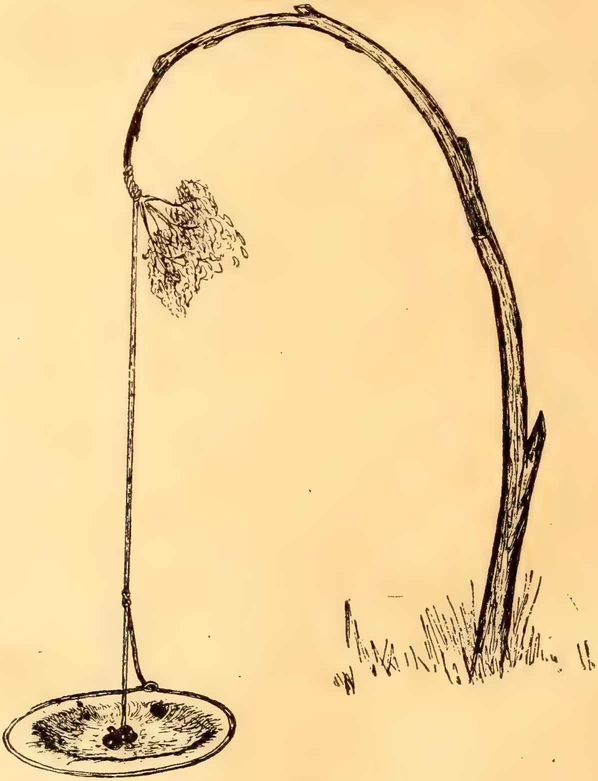
The Muria of Bastar and some of the villages in Orissa use a regular trap with a trap-door. The trap is a two-compartment affair, built of stout stakes hammered well into the ground and roofed with heavy timbers. A partition of thinner stakes divides the two compartments. A heavy trap-door is poised above the entrance to the trap, held in place by a rope tied to a narrow stake against the partition. A pig is placed in the smaller of the two compartments. The panther, in an effort to secure the pig, enters the trap and its scratchings against the partition disturbs the key-stake holding the rope and the trap-door is released to trap the panther. It should be pointed out that the trap is so narrow as to make it impossible for the panther to turn around and attack the baulk of timber that serves as a door. The panther is then disposed of with an arrow through the gaps in the stakes.

THE LEOPARD CAT (*Prionailurus bengalensis*)

THE JUNGLE CAT (*Felis chaus*)

THE INDIAN FOX (*Vulpes bengalensis*)

These three animals, especially the latter two, can be extremely harmful to poultry and—in the case of the two cats—are not averse to destroying goat kids and lambs, whilst the little fox occasionally wreaks havoc in the melon patches and the yam fields. All three are trapped with the spring trap shown in sketch no. 3. This is a very simple trap and consists of bending a springy bamboo or young sapling over. A string ending in a noose is attached to the bamboo and a second string attached to a stake driven lightly into the ground serves to hold the bamboo bent over. A piece of meat or the intestines

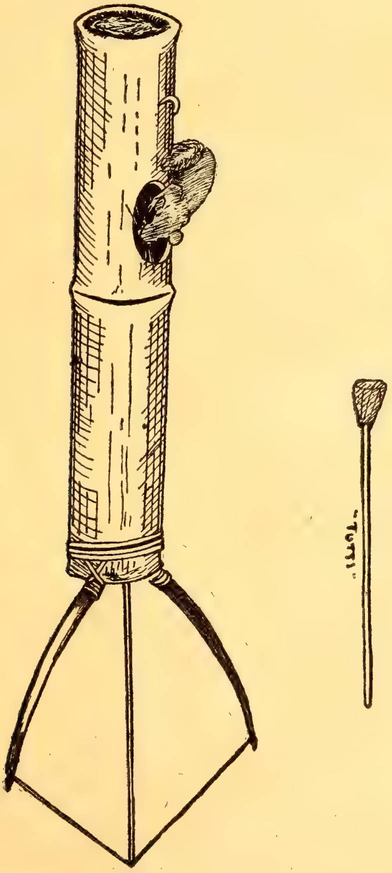


SKETCH 3.—Spring Trap used for wild cats, foxes, hares and peafowl.

of a chicken are firmly lashed to this stake, which is planted in a hollow about four to six inches deep, the noose being laid around the hollow's circumference. The predator, in trying to dislodge the meat, loosens the stake, the bamboo flies back to its normal upright position with the release of tension, and the animal is noosed around the neck or upper body. The bamboo selected is usually about twelve feet tall and the noose-string is about five feet long so that an animal so suspended cannot touch the ground and is usually choked or hangs in mid-air until the trapper destroys it. The Junglecat is eaten as a delicacy by some tribes, especially the Urang.

RATS

All aboriginal tribes mentioned in the introduction eat the field rats which live in their fields and houses. Several traps are used including the spring trap referred to above as well as 'figure four' traps holding up a baulk of timber, which crushes the rat with its weight when released. The Urang have a novel trap, illustrated in sketch number 4, which consists of a hollow bamboo, with an entrance



SKETCH 4.—Urang rat trap.

hole cut into one side. A small bow holding a 'tuti' or blunt-headed arrow is fixed to the open end of the bamboo and the bow-string is held taut by a bamboo splinter, wedged against a node in the bamboo's hollow interior. A morsel of food is fixed to one end of this splinter, the other end being used against the bow string. The rat enters the bamboo in quest of food and dislodges the splinter, whereupon the arrow is released and the rat killed.

The Indian Porcupine (*Hystrix leucura*)

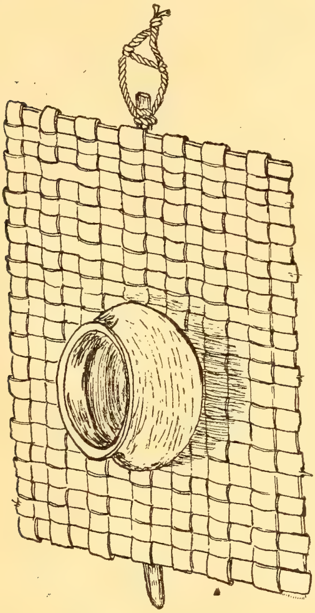
The porcupine is trapped as food or when its destructive inroads into garden produce become intense. Usually the porcupine forces a way through a hedge or tunnels through a bund in order to enter a garden and uses this entry regularly thereafter, and this is its undoing for the aboriginal poises a heavy timber on a delicate figure four in the field just over the tunnel's mouth, the porcupine disturbs the figure four and the timber crushes it. Where there is a scarcity of convenient hedges or fences around gardens, the aboriginal usually erects a narrow box-trap, not unlike the panther trap, and this he baits with some succulent vegetable, usually yams or sweet potatoes, allowing the porcupine to visit the trap for several nights until its suspicions have worn off and it has become a regular nocturnal visitor. The trap is then set with the same heavy timber and figure four as used in hedge-tunnels and the porcupine is crushed. Sometimes, though very seldom, a trap door is employed.

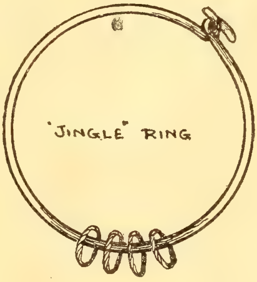
The Common Hare (*Lepus ruficaudatus*)

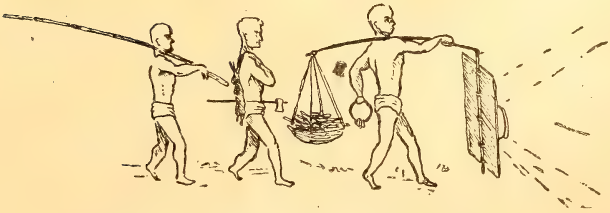
Much sought after by the aboriginal as food, the hare is widely trapped and killed. Several methods are employed. The first is based directly on the hare's habit of running through gaps between bushes, no matter how low these may be, rather than jump over the bushes when flushed. Accordingly, the trapper erects a long low barrier of cut branches in the shape of a large 'V', at the apex of which and at intervals along the arms of which he leaves several small gaps. Each of these gaps is covered with a loose net, the ends of which are firmly pegged to the ground and the hunters then beat the surrounding scrub driving the hares towards the 'V', which they enter, run down the arms in panic diving for any gap, where they are promptly fouled by the net and taken. This is an extremely effective trap and I have yet to see one draw a blank.

The second trap employed is a spring trap as described under the Cats and the Indian Fox, only no shallow pit is dug but grain and rice are sprinkled in the centre of the noose and the hare disturbs the key-stake whilst eating, thus noosing itself.

The third and very successful method of killing hares is the village version of shooting from motor cars at night with the aid of bright headlights. For some reason best known to itself, the hare is scared by a bright light, and the Oriyas of Kalahandi have developed a novel method of hare-hunting, which I have never witnessed elsewhere. An earthen pot with a wide mouth is daubed with white clay and affixed to a woven bamboo screen about three feet wide and four feet high in such a manner that the pot's mouth is facing away from the screen horizontally. This contraption is attached to one end of a 'Kaur' or shoulder pole, as used for carrying loads, and is counterbalanced by a basket filled with small chips of timber at the other end of the 'Kaur'. A fire is made in the pot and the load is shouldered by the chief hunter, who moves rapidly across the fields and open glades, swinging the light from the pot about much in the manner of a searchlight. In his hand he carries a large iron ring, some ten inches in diameter, on which are hung loose some three to four small rings of plaited wire. As he swings his torch here and there he jingles these rings continuously. Behind him walks a general factotum, whose job it is to keep the fire replenished and, later, to carry the bag, whilst behind him again walks the killer, a man armed with a long bamboo pole. All three are very careful to keep directly in the shade of the bamboo screen and so throw no shadows of their own from the firelight. I have tried to illustrate this in sketch no. 5.







Sketch 5.—Oriyas hunting hare.

The jingling of the wire rings apparently attracts the attention of the hares, which look up and are frozen with fear (I surmise it is fear) at the sight of the great glowing 'eye' bearing down on them, their attention being totally held by a very rapid jingling of the wires. The whole party moves rapidly towards the petrified animal until they are within range, when the killer deals the unfortunate beast a deadly blow with his long bamboo. I have been out on these hunts on several occasions. The hunt is always on very dark nights, before the falling of the first dew, and it is always highly successful. However, if one is careless and allows the firelight to throw the shadows of legs or arms across the ground, the hares immediately forget their trance and make a bolt for it, being vigorously pursued with a rapid jingling until they stop and are again hypnotised. The villagers have told me that, on occasion, cheetal deer, and once, a panther have been similarly attracted. In the case of the panther, the chief hunter very carefully placed his load on the ground, the hunters faded into the night and watched the panther stalk the fire-pot, upon which it leaped with a roar that quickly changed to an anguished scream as it burnt itself. This incident was considered extremely humorous and was narrated with much delighted thigh-slapping and guffaws.

THE INDIAN ELEPHANT (*Elephus maximus*)

In parts of southern Bihar and northern Orissa the elephant causes immense damage to the fields. The Elephant Protection Act prohibiting the killing of elephants has led to a situation where the elephant has become so familiar with man as to be contemptuous of him, entering his fields and villages with impunity to eat its fill. It is heart-rending to see a small field of paddy that has been worked over by an elephant and yet there is little one can do about it and the aboriginal is usually content to dig a pit, severely thrashing the elephant that falls into it, after which the elephant is left to climb out as best it can. In the old days, these pits were planted with sharpened stakes or spears but this habit has died out due to fear of the law.

THE INDIAN CHEVROTAIN OR MOUSE-DEER (*Moschiola memina*)

Strangely enough, although deer meat is looked upon with fondness by all aboriginals, in fact the Ho word 'merim' is used for both 'meat' and 'deer'—I suppose because the Ho looks upon all deer as being nothing but meat in an active form—I know of no true traps, apart from the nets referred to under the paragraph on tigers, which, as I have said, I have never seen in use. Most aboriginals are content to stalk deer or beat them to a waiting line of hunters armed with bows or sometimes, as in Orissa, with flintlocks of great vintage or, at most, to ambush them over their regular dung-heaps. However, the mouse-deer is trapped, in one sense of the word, by two simple methods, one of which is rather strenuous.

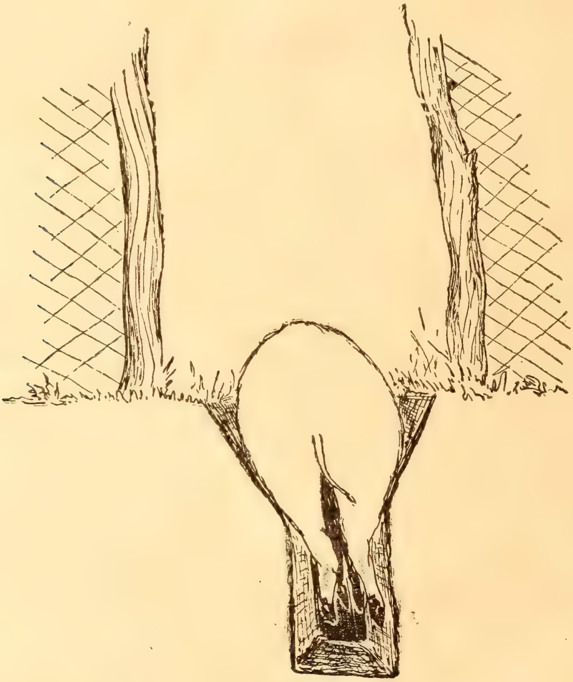
In the jungle, the mouse-deer usually lairs up inside a hollow fallen tree during the day. The aboriginal who discovers such a lair promptly takes off his loin cloth, or, if he has no loin cloth, goes home and fetches a piece of cloth, which is draped over the entrance of the hollow log, which is usually solid for some part of its length. Having covered the entrance as best he can, he commences hammering on the log, proceeding from the entrance up, with the butt of his axe, until the sound tells him he has reached the end of the hollow portion of the log. He then cuts a large hole about two feet away from this solid part, puts in his arm and catches the deer. It is as easy as that because, for some unknown reason, the deer will not attempt to run past the flimsy cloth covering its escape route, whilst the continuous hammering and cutting, the noise of which must be amplified to excess in the confines of the hollow log, send it in retreat as far back as it can get, where it remains apparently dazed by the sound, for it makes no attempt to struggle when caught or at the most will give a couple of ineffective kicks.

The second method is employed during the summer months, when the carpet of dry leaves on the forest floor is thick and piled into drifts. The hunter, knowing the path used by this little deer, conceals himself nearby and, on the arrival of the deer, throws himself into sudden and violent pursuit. The alarmed little animal plunges off the path and, in trying to run through the drifts of dry leaves, punctures them with its sharp hooves so that they accumulate like large anklets around its legs, slowing it down and sometimes stopping it completely, so that the hunter, albeit a trifle puffed by his exertions for these little deer are capable of great speed, successfully captures it. The only parallel with this that I have on other species of deer is when I was invited to hunt sambar by a band of Kutia Khonds in northern Jeypore Samasthanam. I visualised myself sitting on some shady forest-line whilst the beaters worked the deer towards me, and set off in high spirits which quickly waned when I discovered that the Kutia Khond method of hunting sambar is very simple. One simply finds a sambar and runs behind it until it cannot run any more. In this case, I ran from nine in the morning to noon, when finding myself conveniently near my camp I retired modestly. The sambar was brought in that evening. It was explained to me that when the sambar is too tired to run it stands at bay and a member of the hunting party then unslings his axe, walks up to the sambar, grabbing its sweeping antlers with one hand as it swings at him, pushes the head down and delivers the *coup de grâce* with the other hand with a single stroke of the axe. It is a sport I would recommend to those gentlemen of England who derive pleasure from pursuing on horseback a released deer, across someone else's fields with a pack of baying hounds. I think the Khond's method is more sportsmanlike and far more energetic. However, that is a totally different story.

Reverting to mouse-deer, the Saranda Ho tell me that it is also secured in the breeding season—before the monsoon—at least the males are, by the following method. Two hunters go into deep forest and conceal themselves behind some chosen bush. One of the pair then rattles on a large dry leaf with a pair of twigs. This rattling is brisk and staccato and is made in small bursts. Apparently it is the male mouse-deer's challenge to a rival or it may be the means of the female on heat calling any interested males. At any rate, in a short while, there is an answering rattle that comes nearer and nearer until, finally, a male mouse-deer in a fine temper, stalks into sight and is promptly despatched by the second hunter's arrow. I have tried this without success, but it is very probably a correct tale as the Ho does not lie about the forest. It shows an amazingly keen observation of the animal's habits by the aboriginals concerned.

The Indian Wild Boar (*Sus cristatus*)

This great pest and raider of fields is also relished as a great delicacy by all the aboriginals amongst whom I have had the pleasure to live. However, although adept at ambushing pigs at their summer wallows, in their monsoon 'nests', and by the direct beating them out of cover or shooting at them from grass shelters in the fields, no aborgines except the Ho have developed a trap for these beasts. Yet the Ho trap is extremely effective. I illustrate it in sketch no. 6. A field is fenced off and several gaps are left in the fencing. The pigs coming out of the forest at night become accustomed to entering and leaving the field through these gaps and they are allowed to do so without molestation for a few nights. Several of the gaps are then temporarily closed so that, after a few days, the pigs now become used to entering the field through the remaining openings. The temporarily closed gaps are then opened and a 'Y' shaped (in cross section) ditch is dug in each gap, which it should have been explained earlier is just wide enough to allow the passage of a single pig. These ditches are some four feet deep, the upper 'V' section is about 2 feet across and the narrow lower section is



Sketch 6.—Ho trap for wild pig.

about twelve inches across and some two feet deep. The ditch is lightly covered with branches and earth. That night, the pigs enter the field by the gaps which had never been closed and, once they are well into the field and busy foraging, a sudden shout sends them scurrying to safety, and several of them head for the old remembered gaps and there fall into the ditches. Their legs fall into the narrow lower section, where they dangle without touching bottom whilst the weight of their bodies wedges into the upper 'V' section and keeps their legs jammed down uselessly despite all struggling. They are then despatched speedily with heavy clubs.

BIRDS

Although the aboriginal will eat any bird, most of the tribes trap various game birds fairly regularly for the sake of food. I have known Oriya sawyers at Belgarh to enjoy a delicious stew of *Milvus migrans*; Urang youth eat young *Corvus splendens* with relish; Khonds eat *Athene brama* and my Munda bearer could think of nothing tastier than curried callow Green Barbet.

DOVES AND PIGEONS

Nooses made of horse-hair and attached to lengths of fibre rope are spread in the stubble of paddy fields, in which large numbers of doves and pigeons flock to glean in the evenings. This type of snare is common throughout India; so I have no need to describe it in any detail, merely remarking that species I have trapped or seen trapped by the use of these snares are Blue Rock Pigeons (*Columba livia*), Rufous Turtle Doves (*Streptopelia orientalis*), Spotted Doves (*S. chinensis*), Little Brown Doves (*S. senegalensis*), Indian Ring Doves (*S. risoria*) and, once, the Emerald Dove (*Chalcophaps indica*) in Ponga, Saranda R.F.

THE COMMON PEAFOWL (*Pavo cristatus*)

The Peafowl, although sacred in many parts of India, is greatly sought after by the aboriginal tribes so that, in their territories, it is an extremely shy and wary bird. It is snared by nooses across its favourite paths, usually where these enter cultivation on the forest fringe, or it is snared with a spring trap similar to that employed for hares. There are several other methods, however, which are worthy of note. The Urang usually catch it by threading together, on stout twine, several grains of gram. This string of gram is laid in a straight line near other strewn gram and a single bird will usually pick these grains up, swallowing them in quick succession. Since the other end of the string is firmly lashed to a stake or to a bush, the bird finds itself anchored and is thus caught.

The Ho make a very cruel and powerful trap by selecting a young and springy sapling with a fork some eight or ten feet high. This sapling is twisted several times and then bent over so that the prongs of the fork are on the ground. A stake delicately holds the fork down and the area directly beneath the fork is strewn with grain, half buried in the earth. The peafowl, coming across this grain commences pecking and scratching, which latter action disturbs the stake, the sapling immediately jumps up, lifting the peafowl in the fork, and as the sapling violently untwists itself the peafowl is beaten severely on the ground and whirled around in the air, usually with such force that its neck is broken. The violence of the sapling's untwistings combined with the sudden lift is strong enough to lift an average man off his feet and probably break a leg at the same time.

The Oriya plays on the bird's curiosity. When the mhowa is falling, trains of peafowl congregate beneath the mhowa trees to glean the fallen flowers. The Oriya hunter builds a grass lean-to against the bole of such a tree and conceals himself behind it with a leopard skin. The lean-to wall is so constructed that anyone on the outside can dimly see someone inside and this building has an important role in the hunt that follows. Towards the evening, the peafowl emerge and commence picking the fallen flowers. When they are thus busily engaged, the hunter gently rustles the leopard skin against the grass wall of his lean-to, attracting the attention of the peafowl. One would expect them to run away but a most curious thing happens. The panther is an enemy of the peafowl, who always alert to danger keep a sharp eye open for these pests. They hear the rustling under the tree, look up and there is a panther in the grass lean-to. They can see it dimly; it may or may not be a panther and, in order to discover whether it is or not, the silly birds—at other times so cunning and so clever—erect their necks the better to see over the grass, stand very erect exposing the chest to the hunter and commence to walk, almost on tip-toe, toward the hide, all the time making a low 'kok-kok-kok' sound. When they are near enough, a rustle from the hide freezes them for a second and, in that second, the hunter shoots one with an arrow. It flutters about and the others prepare to flee, but a rustle from the hide and a glimpse of that hated spotted coat attracts their attention again like a magnet and the performance is repeated, until the remnant of the train finally decide to call it a day and take flight.

This method of hunting is clever in that the Oriya has learned of the bird's great curiosity in identifying an arch-enemy and has used this lesson to secure the bird easily.

THE RED JUNGLEFOWL (*Gallus gallus*)

The Junglefowl is also a regular item on the menu of aboriginal tribes. It is secured, when gleaning in paddy stubbles with the aid of horse-hair nooses and is sometimes snared as are the peafowl by the Urang and the Ho. However, the commonest method of snaring it is by means of a decoy. A captive bird is usually staked out in the jungle and surrounded by a ring of horse-hair nooses. It commences to crow lustily thus attracting the attention of the nearest wild cock, which, rushing down to do combat, is caught in a noose. If the aboriginal who does not possess a decoy cock wishes to snare one for himself, he will conceal himself beneath a bush, ring himself in with snares, and commence crowing lustily himself with the same result as a decoy cock produces. Even a passable imitation of the crow will suffice, and I have called cocks to the gun this way by merely clapping my hands—a necessary action to simulate the flapping of wings before crowing—and then crowing loudly. The challenge will be immediately answered, and before long a junglecock will make his appearance to do battle.

QUAIL

In southern Bihar, the migratory Common Quail (*Coturnix coturnix*) occurs in great numbers during the winter and is netted in fair quantity. The method of netting is that a low finely meshed net is pegged out over a fairly large area in the stubble of paddy fields. The net is pegged down all round its circumference except at one side where it is propped open and held about ten inches above ground by a series of small sticks joined together with a string, the end of which is payed out into the field. When a flock of quail settle in the field, the trapper, draped in a white sheet and bearing two branches slowly enters the far side of the field bent double. This queer stance and paraphernalia are supposed to represent a cow grazing and, though it may seem ludicrous to human eyes, the quails accept the figure as a cow and are not unduly disturbed. This 'cow' then commences 'grazing' and slowly traverses up and down the field parallel to the net. As it goes to and fro, it comes, closer to the quail, who move away from it so as not to be stamped under by some clumsy foot and so the little drama continues until the quail are beneath the net. Then with a wild shout, the 'cow' pulls the release string dropping the open side of the net and traps the unfortunate quail.

I have sometimes seen *Coturnix coromandelicus* in these catches but it is mostly *Coturnix coturnix* who is the greater sufferer.

THE STONE CURLEW (*Burhinus œdicnemus*)

Living in the more open scrub on the fringe of cultivation, the Stone Curlew falls victim to the Murias of Bastar because it will not cross a mound of ashes. Why it should not do so is not known as it will gladly jump over a line of boulders; it will run over a bund of earth but it draws the line at ashes. It simply will not walk over them or jump over them but must walk around them or in a gap between two ridges of ashes. Thus, the Muria, taking advantage of this weakness, builds a ridge across some favourite path of the plover and leaves a gap through which it may walk. The only snag is that Muria also places a noose of horse-hair in this gap and the plover, treading like Agag delicately, walks straight into the noose and is snared. I can attribute no reason for this behaviour and I often wonder as to which Muria was so observant as to learn of this strange weakness on the part of the bird.

* * * *

Finally, I have not mentioned two methods of capturing animals and birds, both of which are destructive and harmful. The first is the use of bird-lime spread on bared branches or smeared on a broom of twigs which is dropped on the birds. Bird-lime usually snares birds which cannot be considered as 'game' by any stretch of the imagination, and the use of it should be stopped as far as possible.

The other more serious trap is the artificial salt-lick. If you visit Kalahandi, Jeypore and parts of Ganjam, you will run across the artificial salt-lick with alarming frequency once you have won the confidence of the villagers. These licks are made by 'salting' a hollow with human urine over a considerable period of time, the lick being covered over with large boulders so that the animals, attracted to it by the smell, cannot use it until it is adjudged as 'ripe'—this is usually arrived at when it is seen that animals are trying to use the lick in large numbers and with high frequency. The lick is then uncovered and a convenient hide built close to it, and from this hide the 'salter' huntsman usually wreaks havoc amongst the deer and pig that come down to the lick, sparing neither doe nor fawn nor observing close season.

I hear that there is a Sportsmen's Association or something of that sort in Orissa formed by sportsmen and shikaris in that State, and it is hoped that they will take steps to see that the artificial licks are made illegal as soon as possible.

A SUPPLEMENTARY NOTE ON THE STATUS OF RHINOCEROS AND THAMIN (*PANOLIA ELDI THAMIN*) IN THE UNION OF BURMA, 1953

BY

U TUN YIN, B.C.S. (Retd.)

This note is compiled from copies of reports very kindly furnished by the Personal Assistant to the Conservator of Forests, Burma (U Thein Yin), Principal Forest Officer, Shan States, Taunggyi (U Ne Win), and the Conservator of Forests, Northern Circle, Maymyo (U Thein). The writer takes this opportunity to thank the above mentioned forest officers for their readiness in tracing official reports on rhino and supplying him with copies on request.

SHWE-U-DAUNG SANCTUARY

The range officer, Thabeitkyin, continues to receive reports from time to time that the three rhinos reported previously are still surviving in the dense jungles in the upper reaches of the Shwe-Hnyar-U Chaung. (Annual Report on Forest Administration, East Katha Division, 1952-53).

During the Japanese occupation, a villager from Pegu village shot one cow rhino and a school teacher from Thit-Sein-Gon village shot two rhino (sex unkown).

There is a local belief that the best time to come across rhino is during the full moon of Waso (July) when they usually congregate together. (Report on the Shwe-U-Daung Game Sanctuary by Range Officer, Momeik, dated 22nd May 1948.)

UYU RIVER DRAINAGE AREA

'It's pretty hard to estimate the number of rhinoceros in Homalin Sub-Division. I would personally hazard a guess of some seven or eight animals. Rhino tracks (possibly a solitary animal) have been reported from the right bank of the Chindwin north of Nantalaik. There may be one or two animals in the wild interior of Hkamti State.

'I remember a Chin telling me in 1943 how he and a few others shot two rhinos within a week in the Uyu area, west of Chaungson. The Chin village east of Mawngkan is probably doing colossal damage to game and forests.' (W. J. Carrot,[1] Commissioner, Sagaing Division—March 1951.)

The Divisional Forest Officer, Upper Chindwin, Myittha Division, suggests the triangle between Uyu and Chindwin rivers and Taw Sein unclassed forests for reservation as a sanctuary for rhino. Received report that there are rhinos surviving in the Nataleik Yele Forests in the Somra Tract. Not verified. (Annual Report on Forest Administration, Chindwin Circle, 1951-52.) The Divisional Forest Officer, West Katha Division, estimated the number of rhino in

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[1] Mr. W. J. Carrot was Deputy Commissioner, Naga Hills District, till June 1950.

Namka-Za, Nam-Yoke Chaung unclassed forests and the Taungthonlon[1] area as five. The same estimate was given in 1950-51. (Annual Report on Forest Administration, Northern Circle, 1952-53.)

MYITKYINA AREA

'In July 1948, a track of a rhinoceros was seen on the hills of Pao Tan Bum in Pindung Reserve by gamekeeper La Kyon Nawng and the thugyi (headman) of Mayan village. It is believed that the animal crossed over from the Uyu side and went north along the east bank of Namti and Pidaung Chaung (stream) towards the Eimkhing Bum.

'At a place called Kyaukkaik camp near the source of the Tagwin Chaung, Mogoung Range, tracks of another animal are reported to have been discovered as recently as November 1947. From the tracks seen, it is believed that the animal came from the west, crossed the Tagwin and went eastwards.

'In Indawgyi Range tracks of two rhinoceros were seen near the border of the West Katha and this Division near a place called Maingseingyi as recently as September 1948. The animals are believed to have come over from the Uyu drainage and the tracks of an animal indicated that it turned back into that drainage after about a fortnight.' (Memo dated 16th December 1948 from the Divisional Forest Officer, Myitkyina, to the Conservator of Forests, Northern Circle, Maymyo).

TENASSERIM PENINSULA

'Rhinoceros (*Rhinoceros sondaicus* and *Rhinoceros sumatrensis*) were at one time plentiful but owing to the depredations of Thai poachers have greatly decreased in numbers. They are now rarely heard about in any of the well-known forests. One animal may possibly visit the Yebu salt lick, another is on Nwalabo mountain, while occasional animals are reported in other areas. A queer report comes in from time to time that rhinoceros visit Rodger's Island. This report is hardly credible but as it recurs there may be some truth in it.

'In 1889, Anderson stated that rhinoceros found their way to Kisseraing Islands, that at that time they existed on Sir Robert Campbell and Sir Charles Forbes Islands. In those days the dried hide of *Rhinoceros sondaicus* was sold in the Mergui bazaar as food. He stated also that a police officer saw a two-horned rhinoceros swimming near High Island which is a good 20 miles from the mainland although there are islands in sight all round.' [Tavoy Divisional Working Plan (1939-40 to 1958-59) by H. C. Pudden, I.F.S., Deputy Conservator of Forests.]

PANOLIA ELDI THAMIN

THAYETMYO FOREST DIVISION

'Thamin occur mainly in the scrub jungle between the eastern watershed of the Pani stream and the Irrawaddy River. There are possibly 200 animals in this area. Round Sitsayan and Damathaw, south and north of Kama respectively, there are a total of 20-30 animals.' (Divisional Forest Officer, Thayetmyo—October 1947.)

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[1] Taungthonlon is an extinct volcano, 5,600 ft., near the borders of Upper Chindwin and Myitkyina Divisions.

MEIKTILA FOREST DIVISION

'The existing stock has diminished to a very narrow margin and is now confined to the following limits:—

Area	*Estimated stock*	
	Stags	*Hinds*
Meiktila Range:		
Menyotaung reserve and unclassed forest ...	9	22
Inbinwa reserve and unclassed forest ...	10	8
Pyaukseikpin unclassed forest ...	8	20
Tagundaing Range:		
Yupataung and Sintaung unclassed forest ...	10	25
Sathwa range ...	small number	
Myothit range ...	do	

(Divisional Forest Officer, Meiktila—14th March 1951.)

U Aung Din, M.A. (Oxon), B.SC., Silviculturist, informed the writer that he saw thamin on several occasions during his inspection of Meiktila Forest Division in March 1954. He is definite that thamin is on the increase.

'Abundant in the Lower Chindwin, Yaw and Minbu Forest Divisions.' (Annual Report on Forest Administration, Chindwin Circle, Maymyo, 1951-52.)

'West Katha Forest Division, Nam Khan range, Ne-phi-lay unclassed forest: estimated stock 5. East Katha Forest Division—not seen now.' (Annual Report on Forest Administration, Northern Circle, Maymyo, 1952-53.)

Note.—Thamin exist in fair numbers near Kyauk-O, Thabeitkyin Range, East Forest Division (1948-49).

CONCLUSION

'Are there any thamin alive in Burma today?' (Lt.-Col. E. G. Phythian-Adams, *JBNHS*, Vol. 50 (1) p. 10—August 1951.)

Thamin exists and is on the increase in the Union of Burma. The Japs were strict. Ammunition for shot gun was not procurable and there were no shooting parties. Thamin as well as all wild game increased during the war period. It was only on re-occupation that much game was destroyed. During the present Civil War, game is destroyed by peace guerillas who misuse the ammunition supplied by the Government. Whether the insurgents can afford to waste their limited stock on wild game is not known. Ammunition is still scarce. Permit holders are permitted to draw only fifteen rounds at a time (once in two or three years). People dare not venture out to shoot game. In 1948, a party of five guns from Rangoon (Europeans) who went out to shoot junglefowl in the Insein District, were surprised by the insurgents and all their guns and ammunition looted. The Rangoon resident who organised the shoot later received a note from the insurgents that the guns would be returned in exchange for rifles!

REPORT ON THE FORESTS OF THE NORTH TRIANGLE, KACHIN STATE, NORTH BURMA

BY

F. KINGDON-WARD, B.A. (Cantab.), O.B.E., F.L.S., V.M.H.

A general description of the vegetation and flora of North Burma was published in four parts in the *Journal of the Bombay Natural History Society*, Vols. xliv, xlv, xlvi (August 1944 to August 1946), under the comprehensive title 'A Sketch of the Botany and Geography of North Burma'. This is referred to in what follows as 'the earlier monograph'.

The present paper is a direct continuation of those observations, dealing with a part of North Burma not previously mentioned since no botanical collecting had ever been done there—namely, the North Triangle, between the eastern and western branches of the Irrawaddy. Here, between December 1952 and January 1954, my wife and I together with two Burmese colleagues, U Tha Hla and U Chit Ko Ko, seconded from the Burma Forest Department, spent eight and a half months.

Though I have not attempted to reconcile in detail the vegetation zones recognised in the Triangle with those previously discussed, the use of the same names for the same zones leaves no room for confusion.

INTRODUCTION

Our objective in 1953 was the region known as the Triangle, situated in the Kachin State of the Union of Burma, north of Myitkyina. No serious botanical collecting had ever been done in this area; and though, as a result of previous exploration in adjacent areas, it was known what types of vegetation and what sort of flora would occur there, it required and still requires much further work to give a complete picture of North Burma.

The ultimate goal decided on was the group of high peaks forming part of the watershed between the eastern and western branches of the Irrawaddy. It is amongst these peaks that the Hkrang Hka, a left bank tributary of the Mali Hka (or western branch), rises. The approximate position of the group is 26°50′N., 98°15′E., the highest peak called Tamā Bum rising to 11,845 ft. above sea level. I shall refer to them as the Arahku peaks.

The Triangle, whose apex is the confluence of the two branches of the Irrawaddy at Tanghpore, 27 miles above Myitkyina, and whose ill-defined base lies a little north of the 27th parallel of latitude, is entirely mountainous. In fact, North Burma and north-eastern Assam together make up part of the under belly of the Sino-Himalayan plateau, which stretches for 2,000 miles across Asia. This under belly has been so deeply and widely eroded that it no longer bears any outward likeness to a plateau, and has in fact become somewhat detached from the main plateau; and although this isolation is geologically recent (dating only from the beginning of the Pleistocene glaciation), the climatic and other changes then initiated have left indelible marks on the flora.

While, therefore, the vegetation and flora of North Burma in general and of the Mali Hka-Nami Hka watershed in particular could readily be inferred from what was already known of the surrounding areas, there was good reason to think that many new species remained to be discovered, even though the height of the peaks in the Triangle did not warrant belief in an extensive alpine flora. And so it proved.

There would, of course, be less scope for new vegetation types than for new species, since it takes a major climatic change acting over a long period of time to bring about the former, whereas new species may result from much smaller causes and in much less time. We established that the North Triangle had been glaciated, which glaciation lasting through perhaps half a million years, must have brought about a fundamental change of vegetation types; but these types would not differ appreciably from other vegetation types of North Burma, where the marks of glaciation are even plainer.

Change of climate alone, consequent on the Pleistocene glaciation, is, however, not the only reason for the unusually rich and varied flora of North Burma. The dynamic events of the changeful and intermittent ice age have certainly been a major factor, causing migration, extermination, and re-introduction of species. But not less important has been the isolation of areas, the compression and telescoping of several phytogeographical regions within a small area, and the immigration of new species. Here, differences of altitude have played a major role by bringing different floras into three-dimensional contact. (On the plains they can be in two-dimensional contact only.)

Over large parts of the earth's land surface, the phytogeographical regions are in contact, if at all, in two dimensions only, being separated from one another by deserts, by oceans, or by mountain ranges. In the Triangle, as in many other mountainous areas, they are in contact in three dimensions. It is not necessary to follow up all the implications of this truth here; but it is obvious that, whereas the alpine region is the most isolated, the temperate region, between 5,000 and 10,000 ft., is in close and uninterrupted contact with two distinct phytogeographical regions—Indo-Malaysian below, and alpine Sino-Himalayan above; which perhaps accounts for the fact that the temperate zone is the most prolific of all in endemic species.

PREVIOUS WORK

Something was known of the vegetation and flora of four areas of North Burma outside the Triangle, all of which lie within 150 miles of the group of peaks we wished to explore. These areas include:

(i) the Myitkyina plain to the south;

(ii) the Htawgaw and Hpimaw Hills and western Yunnan to the south-east;

(iii) the Hkamti plain and the Seinghku and Adung valleys to the north;

(iv) the Taron valley and Irrawaddy plateau to the north-east. (For an account of the Irrawaddy Plateau see the *Geographical Journal*, October, 1938.)

It was certain that the flora and vegetation of the North Triangle would have a great deal in common with these areas; but even they had been only superficially explored, and there was still a great deal to be learnt about North Burma—particularly in the Triangle, which in the botanical sense, had never been explored at all. A complete list of these previous explorations has been given in the earlier monograph, Part I; so there is no need to repeat it here.

PRELIMINARY PREPARATIONS

After discussing my plans with the Chief Conservator and the Sylviculturist, Burma Forest Department, it was arranged that two Range Officers of the Department, U Tha Hla and U Chit Ko Ko, should join the expedition for training in plant exploration and botany, and to help us in any difficulties which might arise. I cannot speak too highly of their enthusiasm, loyalty, and unselfish co-operation. Thus, the four of us made up a team which worked together harmoniously throughout, to make the most of our unique opportunity. It is certain that my wife and I, the two most experienced members of the team, would not have achieved the results we did without the help of our Burmese colleagues.

We had brought our stores, tents, and equipment out from England, and the business of landing and clearing these, obtaining the necessary permits from the Union and Kachin Governments, and so forth occupied us in Rangoon for six days. My wife and I finally left for Myitkyina on the 18th December, 1952, our Burmese colleagues arranging to join us later.

ROUTE

We left Myitkyina by jeep on the 5th January, 1953, reaching Sumprabum (131 miles by road) on the 7th. Here we halted for two and a half months. The Arahku peaks and the ranges to the north were under snow, and I did not think we should find much in flower in the temperate forest before mid-April; but in this I was mistaken. The time was well spent making a representative collection in the neighbourhood, pushing out stores into the Triangle, purchasing rice, and studying the country.

Seen from here the Arahku peaks, about 50 miles to the north-east, appeared to consist of a series of short, more or less overlapping chains arranged in echelon. Due to their height they are somewhat isolated on the spine of the Triangle, and seem to bear little relation to their visible surroundings; they are like islands in an ocean.

Two days before we set out for Arahku, U Tha Hla and U Chit Ko Ko (who had been delayed by unforeseen difficulties) joined us. They arranged to follow us in a few days.

On the 21st March we started on foot, crossed the Mali Hka at Ningma Daru by dugout, and four days later reached the Hkrang Hka, which we crossed by bamboo raft. Throughout the ten days' journey to Arahku we followed a general north-easterly direction, halting at Arahku for a profitable five days' exploration. On the 7th April we reached Hkinlum, the last village up the main valley and close under the peaks, having marched 86 miles. Here we made our base camp. On the 12th we were joined by U Tha Hla and U Chit Ko Ko; so our party was now complete.

Though Hkinlum is at exactly the same altitude as Sumprabum, we noticed at once that certain trees familiar at the latter place were lacking here; for example, *Ficus benjamina*, *Duabanga sonneratioides*, *Aesculus assamica* (?—or *A. punduana*?), *Shorea assamica*, *Dipterocarpus tuberculatus* (?), *Michelia* sp. nov. (only three specimens found), *Altingia excelsa* and *Terminalia myriocarpa*. Several of these, however, became prominent further down the valley of the Hkrang Hka. Their absence at Hkinlum was obviously connected with the proximity to the high peaks. On the other hand, a number of trees not seen at Sumprabum were prominent at Hkinlum; e.g. *Prunus cerasoides rubella*, *Bucklandia populnea*, *Manglietia caveana*, *Michelia bailloni*, *Alcimandra cathcartii*, *Myrica nagi*, *Acer campbelli* (?), and others. It cannot, however, be too strongly insisted that, below 5,000 ft., the flora of the two areas is essentially the same, such differences as there are being mainly due to minor differences of climate, which here means temperature differences.

CLIMATE

A fairly comprehensive picture of the climate of North Burma is given in the earlier monograph, Part I, and I can add little that is new here. The climate of the Triangle does not differ appreciably from that of other comparable parts of North Burma—that is to say, prolonged summer rain, followed by a drier cold weather. The four seasons are well marked, and become more so with increase of altitude up to about 9,000 ft.

In 1953 spring in Hkinlum (4,000 ft.) was abnormally wet. This was followed by a comparatively rainless August, the break in the monsoon lasting about a month with temperatures up to 90°F. and high humidity. Such August breaks, however, as I recall, are not unusual in North Burma, when little rain falls—and that mostly in the form of short thunder storms, often at night. The fact is that, in mountainous North Burma, microclimates within the general monsoon framework are common. The most obvious deviation from the familiar monsoon climate of Burma is, of course, the presence of a sub-arctic climate in the north (becoming cold-temperate in the Triangle), which affects adjacent areas. Ground frosts occur so low as 4,000 ft. (as at Hkinlum, where the hillsides have been cleared); while above 10,000 ft. snow lies deep for three or four months.

THE VEGETATION TYPES OF THE NORTH TRIANGLE

North Burma is almost completely covered with forest. There are three minor—but none the less important—exceptions to this:

I. *The banks of rivers*, especially between low water mark and flood level; also small areas above high flood level which are covered with sand. (In the latter the vegetation shows a transition to forest, though the species are often peculiar.) This river valley vegetation is, of course, no more than a narrow strip lining either side of the permanent stream bed; but along the many hundreds of miles of rivers, large and small, it amounts to a considerable area, and the immersible vegetation type includes a surprising number of species.

Four distinct habitats are met with:

(*a*) rocky cliffs;
(*b*) pure sand;
(*c*) continuous stretches of comparatively small water-worn stones, with no sand or soil visible between them;
(*d*) piled-up boulders.

Silt rarely occurs, and where it does locally it is due to the presence of a small, slow jungle stream. There are, however, gradations between (*b*), (*c*), and (*d*), with occasional (and often temporary) admixtures of silt. Above flood level, sand is almost always piled up on low shores for a greater or lesser distance; but vertical cliffs, or boulder banks, are followed immediately by thick forest.

Each of the above habitats has its characteristic species, besides species common to more than one habitat. The most interesting plants of this sere (i.e. temporary stage on the way to forest) are those which at some period are more or less submerged, especially shrubs. They may be gregarious, like *Homonoia riparia*, scattered, or in dense mixed thickets, where such plants as *Eugenia*, *Phlogacanthus*, *Phyllanthus*, shrubby *Strobilanthes*, *Mussaenda*, *Ligustrum*, *Rosa*, *Camellia*, *Rhododendron simsii*, and others occur. There is even a species of *Euonymus* with minute flowers.[1]

The leaves of almost every shrub annually submerged are long and narrow, either narrow-lanceolate or linear-lanceolate, and leathery. This is true of all the species mentioned above except *Mussaenda* and *Rosa involucrata* which, with a species of *Phyllanthus* growing under similar conditions, have finely divided leaves. Other examples of narrow-leafed plants are *Ficus pyriformis*, *Scutellaria*, *Salix tetrasperma*, several grasses, ferns, and Cyperaceae. A much smaller, completely prostrate undershrub is the curious *Rhabdia lycioides* which grows in almost pure sand, usually well below high flood level. Herbaceous plants include a creeping fern (*Goniopteris*) and the Arm-like *Cryptocoryne*, which forms compact colonies wedged between stones. Most of this strand flora flowers either in the winter at low water, after the river has begun to fall in October, or in the hot weather of March-April.

From the practical point of view, a knowledge of this river bank sere is imperative for the selection of plants suitable for reclamation work.

It is important to remember that this river bed formation, stabilised at sere level, is open, and can easily absorb many more species, if they can comply with the conditions.

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[1] This is possibly the *lapu shin lap* of the Kachins (Burmee *mway kike* say) a well-known remedy for snake bite (*some* snake bites?).

II. *The zone of cultivation* which extends intermittently from the lower valleys, less than 2,000 ft. above sea level, to about 6,000 ft.: Between these limits, much of the country has been cleared of forest and is covered with crops, or with second growth undergoing several metamorphoses before its final return to climax forest—which of course it is never permitted to do. Cultivation, however, is confined to south and west slopes; north and east slopes, precipitous rocky slopes, gullies and ravines, are untouched. Thus, even within the zone of cultivation, in the most thickly populated districts, a good deal of climax forest survives.

Many widespread herbaceous and undershrub plants occur in this zone. Some of these are found in connection with cultivation all over South-East Asia, and even further afield; certain Compositae and grasses, for example. These plants are provided with good means of dispersal and quickly seize on unoccupied ground as soon it becomes available, either through the felling and burning of forest for *taungya* cultivation, or the cutting of paths.

Many orchids, too, which will not grow inside the dank forests, are able to establish themselves on solitary trees left standing on cultivated slopes. They, like many other herbaceous plants commonly found on roadside banks, are as much a part of the Indo-Malayan flora as are the forest trees, to which they are necessary. They are not, like weeds of cultivation, intruders, though they may appear to be so because in the forest they are much more scattered. Such Indo-Malayan or pantropic herbaceous plants include species of *Begonia*, *Chirita*, *Impatiens*, *Viola*, *Didymocarpus*, *Ohiopogon*, many ground orchids, Cyperaceae, Gramineae, and others.

Some of the most interesting herbaceous plants met with were those which occur only in villages, brought in perhaps long ago from outside by the people themselves. Examples are: *Iris* sp. (allied to *I. wattii*) and *Hemerocallis*, neither of which sets seed, and neither of which grows outside the village, though the iris at least occurs in almost every village. The same is perhaps true of the Tea bush (*Camellia sinensis*) in the warmer zone, and of another species of *Camellia*, which might be a substitute for Tea in the cooler zone found only in Hkinlum and adjacent villages.

The presence of these plants is suggestive, and a knowledge of their occurrence and distribution might furnish valuable clues to anyone enquiring into the history of the hill tribes of North Burma. One feels compelled to ask, who brought these plants here? and when? and whence? Above all, *why?*

III. *The apline zone* on the mountain tops, where they exceed 10,000 ft. This is probably the most extensive non-forested area in North Burma.

The alpine vegetation may consist of elfin wood (especially *Rhododendron* species), or of scrub (also largely *Rhododendron*, with *Prunus*, *Sorbus*, *Vaccinium*), or of *Arundinaria* with a few scattered undershrubs; all three exclude tree growth.

Where the summits reach 17,000 or 18,000 ft. there is an extensive zone above the tree line filled with alpines—the real arctic alpine vegetation, or, as the limit of plant life is approached, open ground with widely scattered herbaceous plants. Even moss and lichens are rare here, and of few species.

At lower altitudes an alpine vegetation clothes the precipitous ridges which lead up to the exposed wind-swept summits. It also descends the steep gullies, which are kept open by running water and falling rocks.

In its extreme form, above 12,000 ft., the alpine vegetation consists of turf and sedge, with many scattered and gregarious flowering plants, either of low stature (*Pleurogyne*, *Lloydia*, *Cremanthodium*, *Gentiana*, *Saxifraga*, *Parnassia*, *Viola*), or forming flat compact mats pressed against the rocks (*Androsace*, *Arenaria*, *Rhododendron*, *Diapensia*) in great variety. This alpine flora is comparable with the European alpine flora, or with the flora of the Arctic; and so also is the vegetation type. It includes a number of endemic genera (*Omphallogramma*, *Cremanthodium*, *Oreosolen*, *Nomocharis*), besides entire sections of large genera such as *Primula* and *Rhododendron*, sufficient to raise the alpine and sub-alpine region of North Burma to the rank of a phytogeographical region (Sino-Himalaya), in spite of a considerable element of Arctic and northern forms.

Not only were there many familiar North Burma alpines here, and a few new species (*Primula*, *Nomocharis*, *Veratrum?*); but a considerable number of species—especially alpine undershrubs common on mountains 15,000 to 18,000 ft. high further north—were lacking on the alpine tops of these lower peaks. For example, we found no species of *Berberis* or dwarf *Lonicera*, and only one species of the following: *Cotoneaster*, *Salix*, *Spiraea*; while two whole series of *Rhododendron* ('*Laponicum*' and '*Saluenense*') could not provide a single species between them. Further north, seven species belonging to these two sections are found in the alpine region. Another widely distributed alpine undershrub—*Potentilla fruticosa*—was not found; but *Rosa omeiensis*, *Vaccinium modestum*, *Sorbus pygmea* (?), and two alpine mat-forming Gaultherias occurred. There was also a dwarf Juniper.

No *Fritillaria*, *Notholirion* or *Meconopsis* was seen; and even the genus *Primula*, in sub-alpine and alpine zones combined, was represented by only four species, of which at least two appear to be new.

Thus, as might be expected, the alpine vegetation of the Arahku peaks—though many species must have remained undetected—was poor compared with that of the higher peaks to north and east. I counted only between 60 and 70 alpine and sub-alpine species together, including *Omphallogramma* (two species), *Cremanthodium*, *Arenaria*, *Pleurogyne*, *Gentiana*, *Saxifraga* (two species), *Bergenia*, *Lloydia*, *Androsace*, *Parnassia*, and *Tofieldia*.

This Sino-Himalayan flora is the most isolated of all the vegetation types of North Burma, and is discontinuous, the mountain top floras being cut off from one another by deep forested valleys. Different ranges running south from the Tibet plateau, though possessing the same general flora, seem to possess species peculiar to themselves.

TYPES OF FOREST IN THE NORTH TRIANGLE

The forest cover of North Burma is divisible into five main types, of which three are represented in the North Triangle; these are stratified according to altitude. The three types represented are:

(i) *Tropical Broad-leafed Evergreen Forest*, which is a northward extension of the Indo-Malayan phytogeographical region. In the Kachin State this type still persists in the low-lying valleys to about 28°N.; and in the Arahku-Hkinlum area it reaches an extreme altitude of about 6,000 ft., though it is more characteristic of the river gorges at 3,000-4,000 ft.

(ii) *Temperate Broad-leafed Rain Forest*, which is in part a westward extension of the East Asiatic phytogeographical region, though separated from China by high mountain ranges and deep gorges. Temperate forest covers most of the North Triangle between 5,000 and 9,000 ft., and includes a great variety of broad-leafed trees, both evergreen and deciduous.

(iii) *Silver Fir—Rhododendron Forest.* This, the highest forest belt, is under snow for at least three months in the year in the Arahku-Hkinlum area, and for six months in the year further north, where the mountains are much higher.

Pine forest, described in the earlier monograph, is entirely lacking in this part of the North Triangle, where we did not meet with a single Pine tree.

Mixed Temperate Forest is also lacking; we found neither *Picea*, *Larix*, nor *Tsuga*. In fact, the only Gymnosperms we noted, other than *Abies*, were a dwarf *Juniper* and *Taxus*—both above 10,000 ft.; and two very rare species down in the valley at 4,000-5,000 ft.—a *Cephalotaxus* (probably *C. manii*) and an unidentified genus with leaves like a *Metasequoia*. This last, a big tree, was exceedingly rare. We saw no sign of *Taiwania*.

The three main forest types briefly mentioned above are further divisible on the basis of dominant families or genera, and species frequency, many species having a considerable vertical range, with of course an optimum altitude. Thus, the broad belt of tropical evergreen forest which fills the deep valleys and spreads upwards into the foothills, can be subdivided into a lower, narrow tropical belt, and an upper, broader sub-tropical belt, although at intermediate altitudes the distinction between them is necessarily blurred. It is worth noting, however, that a change of forest type is almost always accompanied by a change in the dominant Bamboo genus, or species.

Again, in the temperate belt, a distinction between the lower warm-temperate and the upper cool-temperate forest is not difficult to uphold. We may therefore recognise five forest types in the North Triangle, out of the eight described for North Burma in the earlier monograph. It will be useful to give a brief account of each, mentioning a few of the more outstanding trees; a fuller account must await the working out of our collections.

I. Tropical Evergreen Rain Forest

This type is barely represented in the Arahku-Hkinlum area, and need not detain us. Even at 3,000 ft. altitude, where the summers are hot, and no frost enters, and with ample atmospheric humidity throughout the year, the effect of the adjacent high peaks is already beginning to make itself felt. A number of trees mentioned in the earlier monograph as characteristic of this zone (e.g. *Terminalia myriocarpa*, *Mesua ferrea*, *Duabanga sonneratioides*, *Gmelina arborea*, *Dipterocarpus*, *Shorea*, *Spondias*), though occurring lower down the valley, had disappeared before we reached Hkinlum. Nevertheless, the forest lining the Hkrang Hka gorge, though composed largely of species not seen at Sumprabum—or even in the valley of the Mali Hka—comes within our conception of tropical forest. Common trees here include species of *Elaeocarpus* (at least four species), *Echinocarpus*, *Styrax* (two or three species), *Eugenia*, *Manglietia*, *Albizzia*, *Dipterocarpus*, *Shorea*, *Spondias*), though occurring lower down the one strangling species), besides several big Laurels, Euphorbiaceae, Rubiaceae, and others. Though forming only a small proportion of the total forest, this zone is interesting by reason of several rare species, and of importance because of its lining the steep river banks —rivers being the only economic means of transport under present conditions. The rarest tree met with—a single specimen of *Cephalotaxus* (and the strangest plant—an epiphytic Lily of the 'Martagon' type) belong to the borderline between tropical and sub-tropical forest.

II. Sub-Tropical Hill Jungle

This is well represented in the North Triangle between 4,000 and 6,000 ft., above which it passes gradually into a definitely temperate forest type. It lies entirely within the zone of cultivation, and on south and west slopes is represented mainly by second growth which, however, may include woodland of 20 or more years' standing. (Such woodland is set aside for furnishing building poles.)

By far the most interesting tree is a tall Gymnosperm whose identity, in the absence of flowers or fruit, we were unable to determine; though microscopic examination of the wood is likely to furnish a clue. It is an extremely rare species, at least as a fully grown tree. Common are species of *Diospyros*, *Rhus*, *Pieris*, *Schima*, *Elaeocarpus*, *Terminalia* (?), *Styrax grandiflora*, *Zanthoxylum*; also *Altingia excelsa*, *Erythrina indica*, *Alnus nepalensis*, *Bucklandia populnea*, *Manglietia*, *caveana*. Less common were *Helicia*, *Ternstroemia*, *Eriobotrya*, and *Sterculia* (a small tree with reddish flowers like *S. coccinea*), and the very rare conifer, like *Metasequoia*, just mentioned.

The majority of the species in the sub-tropical belt belong to a few families only, notable to Fagaceae (*Quercus/Pasania*, *Castanopsis*), Rutaceae, Magnoliaceae (*Magnolia/Michelia*), Theaceae, Rubiaceae, Lauraceae, and Moraceae (*Morus laevigata*, *Ficus*), together with the genera mentioned above.

Climbing plants abound in this warm damp climate, and include species of *Clematis*, *Lonicera*, *Jasminum*, *Smilax*, *Vitis*, *Vernonia*, several Asclepiadaceae and Apocyanaceae. Frequent scramblers are *Toddalia aculeata* and *Aspidopterys* sp.

Characteristic and abundant is the epiphytic flora, including many Orchidaceae and ferns, Ericaceae (*Rhododendron dendricola*, *Vaccinium*, *Agapetes*, *Pentapterygium*), Asclepiadaceae, species of *Hedychium*, and so forth; also the lily just mentioned.

The composition of the hill jungle, however, varies considerably with its distance from the high peaks. Nearer the peaks, the more tropical families rapidly decrease, while the more temperate families increase in numbers and variety.

There are many useful and possibly valuable timbers, but no species forms pure stands; and extraction, except perhaps close to the larger streams, is a major problem.

III. Warm-Temperate Rain Forest (5,000-7,000 ft.): Cool-Temperate Rain Forest (7,000-9,000 ft.)

In the North Triangle this type agrees fairly closely with the description given in the earlier monograph; the differences noted are mainly those of composition, a number of new species being added, while many of those mentioned as characteristic (e.g. *Decaisnea*, *Dobinea*, *Pottingeria*), were not met with in the Arahku-Hkinlum area.

Perhaps the most striking trees of the Warm-Temperate belt are *Gordonia axillaris*, with flowers six inches in diameter, *Rhodoleia forrestii*, *Helicia excelsa*, and several species of *Rhododendron*, including *R. stenaulum*, *R. genesterianum*, and a 'Ciliicalyx' species. Oaks, Laurels and Magnoliaceae abound; also a species of *Calamus* which ascends to nearly 7,000 ft. The epiphytic flora, which includes several shrubs—notably *Agapetes*—is varied; but climbing plants, lacking the summer heat they need, are on the down grade.

There are a few deciduous trees, but not enough to colour the autumn forest. On the other hand, several autumn-flowering trees are sufficiently abundant to brighten the slopes in November.

Several of the trees mentioned serve to indicate the upper limit of the warm-temperate zone, but the dividing line must never be regarded as fixed; on the contrary, the number of genera with species in several zones, ranging sometimes through 6,000 ft., is a measure not only of its fluidity, but also of the fierce, continuous struggle which goes on always between the floras of two superimposed phytogeographical regions to extend their boundaries.

This is apparent not only regarding familiar genera such as *Ilex*, *Castanopsis*, *Quercus*, *Rhododendron*, and *Acer* (4,000 to 9,000 ft.), but equally amongst others less familiar, such as *Eriobotrya* (4,000, 7,000 ft.); *Helicia* (3,500, 6,500 ft.); *Styrax* (four or five species, 3,500 to 8,000 ft.); *Pieris* (3,500 to 9,500 ft.); *Schima* (4,000 to 8,500 ft.); and *Symplocos* (3,500 to 9,500 ft.). *Bucklandia populnea*, to mention but one species, has a vertical range of over 4,000 ft. in the Arahku-Hkinlum area.

Thus mutual pressure is exerted by one phytogeographical region on another, not only laterally where these adjoin, but also vertically in the mountains.

The next zone, the Cool Temperate forest, in latitude 27°N. is in some respects equivalent to the forests of lower altitudes in much higher latitudes—perhaps to those of the moister parts of western Europe. Its composition is, however, partly Eastern Asiatic. Here autumn colour becomes a major feature; indeed, the forests flush with colour twice a year—in spring, when the magnolias, rhododendrons and cherries come into blossom, and the breaking leaf-buds add a rich mosaic of greens, yellows, purples, and reds; and again in autumn when the dying year flings a patchwork of scarlet and gold over the hillsides.

Amongst the most brilliant trees at this season may be counted *Sorbus*, *Acer*, *Viburnum*, *Gamblea*, *Enkianthus*, and *Pyrus*. During the height of the rains, however, and in the depth of winter, the temperate forest is sombre indeed; for the truth is that even at 9,000-10,000 ft. it is still largely evergreen, with rhododendrons, *Ilex*, *Symplocos*, oaks, some laurels, and some Magnoliaceae retaining their leaves; while other trees (e.g. *Eriobotrya* sp.) are naked only for a very short time.

This is the zone of the big-leafed tree rhododendrons, of *R. sino-grande* and others, one of which, with glorious yellow flowers, was outstanding in May. (We did not see any of the others in bloom.) The big-leafed species ('*grande*' and '*falconeri*' series) at 9,000 ft. tend to form almost pure Rhododendron forest; and though their trunks are gnarled and twisted to an extraordinary degree, they are large enough and abundant enough to provide an unlimited supply of timber for special purposes. The wood is extremely hard and close-grained, and takes a good polish. It would be valuable for veneer and panelling. These trees seemed to be immortal; I estimated many of them to be over 200 years old, and rarely did we see a dead rhododendron.

There is also a great variety of shrub rhododendrons, including a number of epiphytic species. In fact, in the cool-temperate forest *Rhododendron* and *Magnolia* are dominant genera, so much so that it might properly be defined as the zone of Magnoliaceae and Ericaceae.

Notable trees are *Magnolia rostrata* and *M. Campbellii* (*mollicomata*), *Ilex crenata nothofagifolia* (very different in appearance from the Japanese *I. crenata*), and *I. sikkimense*, *Acer wardii* and *A. sikkimensis*, and species of *Tetracentron*, *Zanthoxylum*, *Michelia*, *Eriobotrya*, *Schima*, *Betula*, *Styrax*, *Illicium*, and several large Araliaceae and Fagaceae (*Quercus lamellosa* and *Q. pachyphylla*).

Two species of *Primula petiolares* and a 'Candelabra' species—likewise belong to this zone, together with species of *Begonia*, several ground orchids, and a few Compositae.

A noted feature is the swathing of the big trees with moss, which not only pads the trunks but hangs in long festoons from the limbs. In this moss a variety of perennial epiphytes, both woody and herbaceous, spring up from seed; in fact, there is hardly a tree in the forest which cannot start life thus, while many continue as epiphytes all their lives, and when fully grown are often connected with the earth as well, by means of a great root which has grown down the side of the trunk till it reached the ground (e.g. *Sorbus*). They are partial epiphytes. The thin-barked rhododendrons, however, carry no moss.

It is surprising that neither in this, nor in any higher zone, did we meet with a single species of *Berberis*, so many species of which occur further north; and with only one species of *Cotoneaster*.

IV. Rhododendron-Silver Fir Forest

The Burmese, and probably Chinese, Silver Fir is found on sheltered slopes as low as 9,000 ft. in the North Triangle, as high as 12,000 ft. in North Burma generally. Though it forms practically pure stands, the trees are rather far apart, the intervening space being filled with *Arundinaria* and *Rhododendron arizelum*—one of the big-leafed trees, and to a lesser extent with another tree species of the 'Thomsoni' species. In the earlier monograph I referred the Burmese Silver Fir to *Abies fargesii*; but whether the North Triangle tree is this species or not remains to be seen.

A number of broad-leafed, mostly deciduous trees are associated with the Silver Fir, notably *Gamblea*, *Clethra delavayi* (?), *Pyrus*, and *Sorbus insignis* (*S. harroviana*?); besides numerous shrubs, especially species of *Rhododendron* and *Gaultheria*. It may be remarked that *Abies* is practically confined at this altitude to the more sheltered slopes, being unable to withstand bright sunshine. Hence, in this zone we find three distinct plant associations: (i) sheltered slopes covered with Abies—Rhododendron forest; (ii) exposed slopes, with Rhododendron—broad-leafed deciduous trees, mostly of small size; and (iii) ridges which, being exposed to both wind and sun, are covered mainly with mixed shrub growth of low stature, including many species of rhododendron [*RR. tephropeplum*, *telopeum* (?), *trichocladum*, *polyandrum*, and others], mixed with *Euonymus*, *Enkianthus*, *Symplocos*, *Viburnum*, *Gaultheria*, *Vaccinium glauco-album*, *Taxus*, and many other species. All three associations have *Arundianaria* as a fill-in.

Another point of interest is that *Abies*, the only tree other than rhododendron to form pure stands, is local in its occurrence. Thus, while it was a dominant on Tama Bum at 10,000-11,000 ft., we did not come across a single tree on Tagūlam Bum, only a few miles to the north and very little less in altitude. One gets the impression that, though a tough-looking tree, it is in reality sensitive to slight differences in climate.

There was no sub-alpine meadow association within this zone (or, indeed, anywhere else) such as is typical of the higher ranges along the China-Tibet frontier. The nearest approach to this was in the steep, sheltered gullies, which, being drained dry in their upper parts by October, carried only a limited variety of coarse herbaceous plants, forming nevertheless a type of sere. The more outstanding plants in these gullies were: *Caltha*, *Cimicifuga*, *Nomocharis*, *Polygonum*, *Luzula*, *Pedicularis*, *Rodgersia*, *Astilbe*, and several Compositae with large leaves; besides a few shrubs, including a *Lonicera*.

FOREST IN GENERAL

Since the various types of forest are in three-dimensional contact, as opposed to two-dimensional contact on flat land, over wide areas a good deal of interchange of species takes place. Every zone tries to expand its boundaries, and incorporate within itself something of the zone below and the zone above. Even alpine species penetrate as far down the gullies as they can, while cool temperate species strive to become alpines. This, of course, is what one would expect, since there are always transitional zones; nothing is hard and fast.

But while species may, and often do transgress boundaries, different species of the same genus regularly occupy different zones. Obvious examples in North Burma are *Rhododendron*, with species in every zone from 1,000 ft. above sea level (*R. simsii*) to 14,000 ft. (*R. chryseum*); and *Ficus*, with species in all zones between 1,000 ft. and 10,000 ft. But whereas the former is much more abundant above 8,000 ft. than it is below, the latter is far better represented at 2,000 ft. than it is at 9,000 ft. Hence, one suspects that *Ficus* is a tropical genus which has worked its way up to a temperate climate, while *Rhododendron* is a temperate genus which has worked its way down to a tropical climate.

Certain species of *Rhododendron*, having become gregarious, have made their own small zones, e.g. *RR. sino-grande* and *arizelum*, which form together, or with other species, or even alone, a zone of rhododendron forest, while others form rhododendron scrub. Whole sections of the genus are confined to particular zones. This, however, is not exceptional; rather is it the rule, though on a less generous scale.

Amongst common genera which have overflowed into two or more zones one might mention *Quercus*, *Acer*, *Ilex*, *Magnolia*, *Michelia*, *Elaeocarpus* (mainly in the lower zone, however), *Euonymus*, and *Prunus*. Of all these we met with several species. In the North Triangle also grows a species of *Rehderodendron*, quite a common constituent of the forest between 4,000 and 5,000 ft.; at 8,000 ft. it was replaced by a second species. The same with *Helicia* (Proteaceae)—one species at 4,000 ft., a second at 7,000 ft.; while *Eriobotrya* had four species, the lowest at 4,500 ft., the highest at 7,500 ft.

Alpines, too, try to extend their territory downwards, e.g. a species of *Nomocharis*, found inside the forest at 8,500 ft., and on the open ridge at 10,000 ft.

The fact that one finds such a genus as *Symplocos*, usually reckoned as sub-tropical, at 8,500 ft., and various Lauraceae at 8,000-9,000 ft., is another indication of the concerted attempts being made by the lower zones to extend upwards.

It is worth noting that the green fruits of *Rehderodendron* sp. from 4,000 ft. are regularly eaten (i.e. the rind) by the local inhabitants.

It will be remarked that we actually passed through three main vegetation belts or climax, belonging to three different phytogeographical regions:

(i) Tropical Indo-Malayasian forest;

(ii) Temperate forest (Eastern Asiatic and Northern phytogeographical regions);

(iii) Alpine (which comprises a region by itself) Sino-Himalayan.

In the latest exposition of phytogeographical regions, Prof. Ronald Good has increased the number formerly recognised to 36.[1]

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[1] The Geography of the Flowering Plants, 1st edition, London 1947.

That the number must be increased as we get to know more and more of the world's flora, and the distribution of species and genera, is highly probable. But Prof. Good seems to me to be in advance of our certain knowledge. How many divisions we allow depends, of course, mainly on what degree of peculiarity—especially endemism and its degree (specific, generic, or family)—we insist on. (Prof. Good himself doubts the justification for his Continental South-east Asiatic Region.) It also depends on the results of continued exploration.

For the present I am conservative enough to keep to the old comprehensive Indo-Malaysian region. We hardly know enough about the huge flora of Indo-Malaysia as yet to sub-divide it. Such knowledge as we do possess suggests that the first sub-divisions to make would be to detach Ceylon as a separate region, in spite of its proximity to India.

ECONOMICS

The question arises: have these extensive forests any economic future? Are there any valuable products and, if so, is it possible, or worth while, to extract them?

The absence of pure stands of any big tree other than *Abies*—the most inaccessible of all—suggests that the answer is an immediate 'no'. On the other hand, it seems certain that many useful, even valuable, hardwoods occur at much lower altitudes, though even here the problem of extraction, at any rate on a big scale, is almost insoluble. Two possible methods, however, may be briefly referred to:

(i) It would be worth while to test the Mali Hka and Hkrang Hka (below Laja a fair-sized river, especially during the rains) for floating logs down to Myitkyina; though it is certain that there would be awkward places where jams would occur. Thus, it would be necessary to maintain a series of patrols, with knowledge of how to free logs, along the banks. It might be advisable to obtain the services of lumberjacks from Canada or elsewhere to train the necessary personnel.

The Mali Hka should, of course, be tested first, by throwing in, say, one hundred marked logs at the Hkrang Hka confluence and keeping a watch for them at Tanghpre; though even here patrols might be necessary. If this proved successful, tests might be carried out on the Hkrang Hka from Laja (above which village the river rapidly breaks up). The fact that heavy planks (not logs) are successfully floated down the Ngawchang Hka—a river little superior, if any, in size to the Hkrang Hka—suggests that it would be worth while to examine the possibilities of the latter river.

Only trees which grow close to the river could be regarded as accessible, whereas many of the more promising timbers grow high up in the temperate zone, far above the river. These, however, are not for ever out of reach, if the methods adopted in western China and in Tibet are adopted and developed. There, stout building poles are cut and roughly shaped in the forest, high above the villages. A narrow gutter is then cut straight down the steep mountain face, along which the poles are dragged with ease. As the gutter becomes smoother with constant friction, and in winter when it becomes filled with snow (rapidly compacted into ice), the effort required is much diminished. Admittedly, conditions in the North Triangle are very different. The heavy summer rain would tend to deepen and roughen the gutters; and it is only where the mountains exceed 12,000 ft. that there is any great quantity of snow descending so low as 9,000 ft. But taking the long-term view, it might be possible to develop a system of timber slide and river transport adapted to local conditions. (For example, a gutter lined with bamboos laid lengthwise would be extremely slippery.) It is not suggested that timber could be extracted thus on a commercial scale; but it seems a pity that with water available, its possible uses should not be explored.

(ii) In the Htawgaw Hills (south-east Kachin State) the Chinese export—or used to export—heavy coffin planks cut from the Gymnosperm *Taiwania cryptomerioides*. These coffin planks, weighing from 80 to 100 lb. each, were carried one by one some ten days journey over the high dividing range to Tengchung in Yunnan—a journey which involved crossing the Hpimaw Pass, 10,000 ft. high. It would be impossible to extract logs of this big tree—one of the largest in the forests of North Burma; but by cutting the planks to the required shape at the spot where each tree is felled (*Taiwania* does not grow in pure stands), floating them down the Ngawchang Hka, seasoning them for a year, and using human transport, thousands of coffins have been made and sold. Chinese carpenters are sent into the Kachin State to cut the planks; and the industry, though a small and luxury trade, is well organised.[1]

It will be observed that both the above methods of extraction from difficult terrain, as practised today, depend upon a special technique applied to a particular species required for a known purpose. In Canada, soft woods are required on a huge scale for the immense paper pulp industry, the pulping machinery being sited on the river used for floating the logs, as high up the valley as possible. In the second example, the extraction of a single species of soft wood for the manufacture of one article—coffins—in limited but steady demand shows what is possible with scattered trees.

It is suggested that, since it is not possible to extract timber wholesale from the North Triangle, efforts should be made to extract planks, provided that they have a certain known value for a particular purpose.

Before this could be done, it would be essential to know more about the forests—what species occur there, in what quantity, and for what particular purpose they would prove most useful. Until more information is available, it would be a mistake to embark on extensive and expensive operations. Indeed, it is of the greatest importance to know what raw materials exist, and to develop such a potentially valuable industry step by step. The emphasis here is on exploration.

Apart from timber, the forests yield minor products used in the arts—many species of bamboo and cane, for example, used by the local inhabitants for a variety of purposes, from water pots and drinking vessels to suspension bridges and house floors.

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[1] See The Chinese Coffin Tree, *Geographical Magazine* (London), November 1952.

Another potential minor product is horticultural plants; and here again there is scope for further exploration to reveal new species which will always be in demand. First place may be given to orchids, so popular nowadays everywhere—even in countries with a cold climate. The forests of the Kachin State are as rich in orchids as is any other part of the world of equal area; and there are even a few species of considerable merit, which are under snow for a few months each year. But, as already pointed out in an article in the *Burmese Forester*, the exploitation of these is best left to private enterprise. It may be said categorically, however, that anyone who took up with enthusiasm the cultivation of Burmese orchids for export could earn a living.

Secondly, there is ample material in the mountains for a successful seed, or even nursery business, although for the latter purpose capital would be required and the nursery would have to be in the hills. There are potential markets all over the temperate world, and the higher mountain tops everywhere are covered with desirable horticultural plants, the seeds of which would find a ready sale, yielding a modest profit. A successful seed business has been set up in Darjeeling, while in Japan there are a number of exporting nursery firms.

Any such business must be content with a modest start, and knowledge—often bought at a price—is needed as well as enthusiasm; but the good taste of the Burmese is a valuable asset in the choice of suitable plants. The expense of collecting orchids and seeds would be negligible.

Lastly, mention must be made of medicinal plants, many of which find a ready sale in China. We did not come across the oft-acclaimed *machit* (the Kachin word; botanically, *Fritillaria roylei*), because the mountains we were exploring are not sufficiently high for this species. It can confidently be asserted that it does not occur anywhere south of Putao (except possibly east of the Taron); but it is abundant further north, at altitudes of over 12,000 ft.

Coptis teeta, another favourite Chinese drug (*hwang-lien* is the Chinese name), is not rare in the forests above Hkinlum at 7,000-8,000 ft.; and where it occurs its spread is easily induced by clearing the undergrowth. It would, however, be profitable to cultivate it on a much larger scale, concentrating it in one place. Only the yellow root is used, so that its collection involves the death of the plant. The best method would be to raise it in fields and plough it up when mature, replanting the fields in rotation. It is, however, a forest plant requiring heavy shade, and the best method of cultivation would be a matter for experiment.

There is also the plant known locally as *Mashaw tsi*, after the village of Mashaw (between Htingnam and Laja), which is reputed to have a monopoly not only of its sale but also of its occurrence! The claim seems extravagant. To bolster up the myth of exclusiveness, stories are circulated locally of its peculiar appearance—stories which to the botanist hardly ring true. However, we were unable to break through the veil of secrecy which envelopes this plant, and ascertain its relationships. Substitutes are readily palmed off on the too curious, though there is some evidence in favour of its being a species of *Euonymus*. During our sojourn at Hkinlum the discoverer of this patent medicine, who called himself the Mashawtsi Duwa, died; but his mantle doubtless descended on another member of the family.

The one authentic fact which emerges from the cloud of rumour and speculation concerning this mysterious plant is that it is used mainly in connection with poisoning including alcoholic poisoning (or more briefly, drunkenness), and with undoubtedly good effect, as reported by a doctor in the district.

These notes on the flora and vegetation of the North Triangle do not claim to be exhaustive, and indeed, until the collections made by U Tha Hla and U Chit Ko Ko and by ourselves have been worked out (a long job, since the total number of species is about 1,500), no complete account of our joint discoveries is possible. Incomplete as it is, however, it should, in conjunction with the valuable field notes made by U Tha Hla, prove of some interest to the Forest Departments of Burma and India.

FOOD OF THE INDIAN GERBILLE *TATERA INDICA CUVIERI* (WATERHOUSE)

BY

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(*With one histogram*)

In an earlier paper (Prasad, 1954)) the natural history of the gerbille, *Tatera indica cuvieri*, has been described. In spite of its occurrence in large numbers and the admitted knowledge of its depredations on field crops, we have no adequate account of its food and feeding habits.

Gerbilles are nocturnal and seldom venture out during the day. Blanford (1891) states that these animals store a part of the grain in their burrows, but my examination of their burrow systems presented no indication of such a tendency. Consequently one has to adopt the expedient of examining the stomach contents to ascertain the type as well as the variety of food eaten. If the stomach contents are examined within an hour after feeding, the different constituents can be identified with little effort. Seeds are recognised by their hard outer coats, insect remains by wings, fragments of appendages, tracheal tubes and exoskeletons, while leaves and stems of plants which serve as food are made out by their colour and vascular structure. Rhizomes of grasses can be identified by their outer coats and roots attached to them.

Stomach contents were examined soon after the gerbilles were captured in the morning. The animals feed during the night and return to their burrows at dawn. The stomach was split and emptied of its contents into a trough containing a little water. The mixture was agitated and allowed to settle down, when the separation of the components could be effected easily. The volume of each kind of food was estimated to the nearest 10 per cent. More accurate estimation did not seem necessary since in a natural population there is generally a slight variation in the food items consumed.

The environment and vegetation of the area under investigation (Shivanahalli village, 3 miles from Bangalore, Mysore State, India) have been described in the earlier paper referred to. The concentration of the gerbilles in a given area depends to a great extent on the availability of food in sufficiently large quantities throughout the year.

Table I

Food of the gerbille, *Tatera indica cuvieri*, in Shivanahalli village, Bangalore District, India, in 1953. Volume—per cent. The figures in parentheses indicate the number of gerbille stomachs examined in each month and the percentage represents the average of the total number of animals examined.

Food	January (10)	February (11)	March (9)	April (10)	May (8)	June (11)	July (8)	August (12)	September (12)	October (10)	November (13)	December (12)
Seeds ...	60	50	25	10	00	20	25	10	00	15	25	50
Stems and Leaves.	10	10	15	15	10	10	10	20	15	15	10	10
Rhizomes-grasses.	10	20	35	45	50	45	35	40	50	40	35	20
Insects ...	10	10	15	20	25	25	30	20	25	20	20	10
Miscellaneous ...	10	10	10	10	15	00	00	10	10	10	10	10

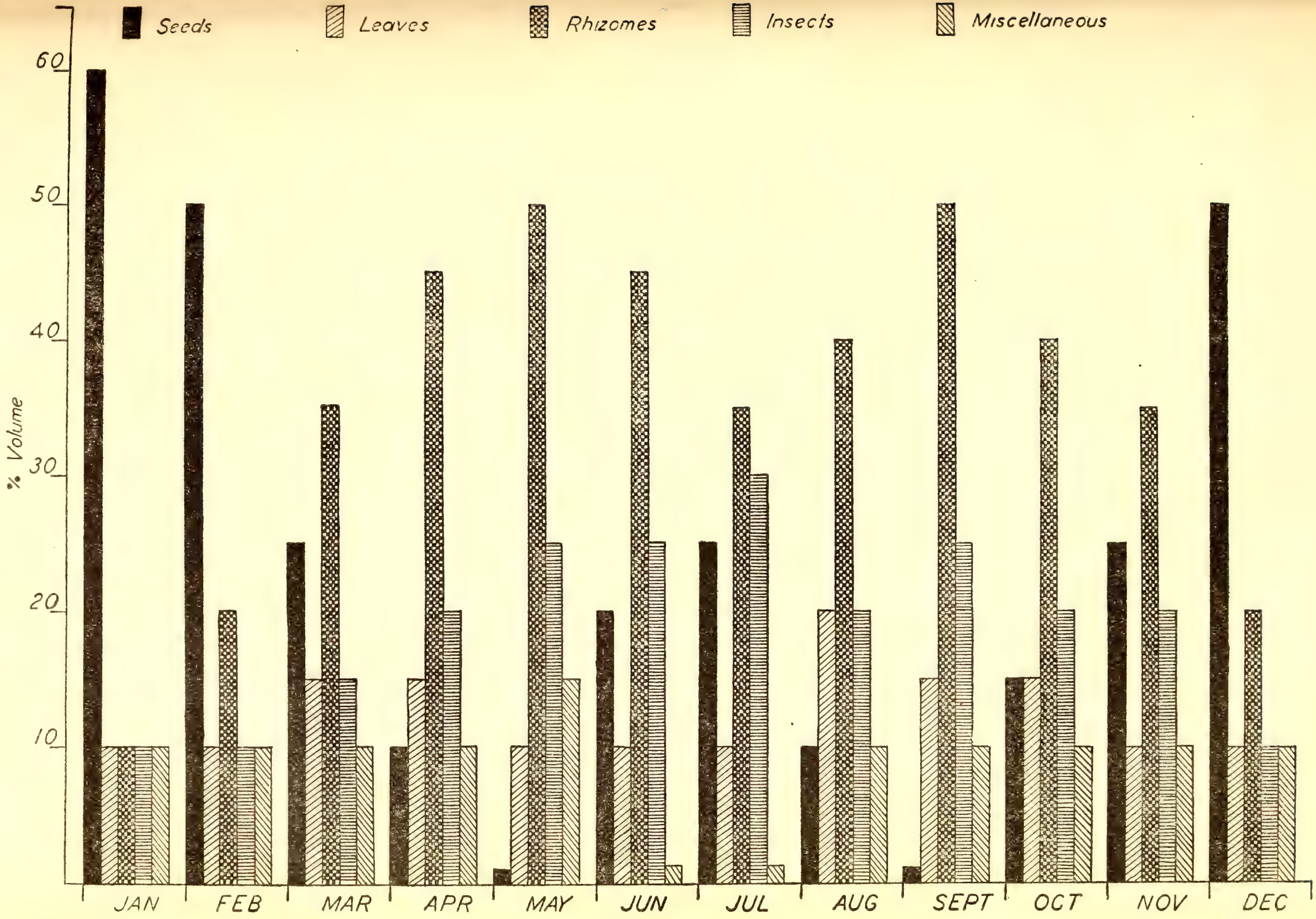
It will be seen both from the table as well as the histogram that the relative food constituents vary in the different seasons of the year and with the food material available in the neighbourhood.

June to August:

At the end of the hot weather period the fields are bare and bereft of vegetation. With the onset of the south-west monsoon in the last week of May brisk farming activity is initiated and sowing operations begin by the third or fourth week of June. Sown seeds offer a good source of food during this period. The food also consists of rhizomes of a variety of grasses growing in and around the fields, namely: *Cynodon dactylon*, *Brachiaria distachya*, *Urocholoa reptans*, *Setaria intermedia*, *Sporobolus* sp., *Eragrostis bifaria*, etc. The advent of the monsoon and accompanying strong winds bring large numbers of dragonflies and these form an important constituent of the gerbille stomach for a fairly long period. It was not possible to identify the genera of the dragonflies. In July the sprouted seeds form the food. With the emergence of the saplings a little later, a new kind of food becomes available and the fields are also full of the different varieties of grasses already listed.

September to November:

During this period seeds form a rather small percentage of the food. Since all the seeds have either sprouted or been eaten up by now, the gerbilles become more and more dependent on other food like the rhizomes of grasses and insects. A large number of cutworms belonging to the species *Laphygma exigua* and *Euxoa sagetum* which



Histogram showing Seasonal Food Constituents of the Indian Gerbille.

cause damage to Ragi (*Eleusine coracana*) appear at this time and the gerbilles consume them in considerable numbers, thus helping in their control. In the middle of October a few of the early earheads of ragi and jola (*Andropogon sorghum*) ripen and the gerbilles feed on them. The percentage of seeds in the stomach increases gradually from now on, as ripening of the earheads progresses. This is the beginning of the breeding season and the first litters are brought forth in the third week of September. Intra-specific struggle and evidences of cannibalism are evidenced in the stomachs of a few gerbilles examined during October and November.

December to February:

This is the period of plenty and the fields are all full of crops ready for the harvest. Gerbilles cut the earheads of ragi and jola and gather the seeds. With this increase in the percentage of seeds taken, other items normally consumed in the earlier seasons show a gradual decline, though a considerable variety is still maintained. The grain crops are harvested in the middle of December. Since a mixed crop of the following plants, i.e. avare (*Dolichos lablab*), red gram (*Cajanus indicus*), Bengal gram (*Cicer arietinum*), horse gram (*Dolichos biflorus*), black gram (*Phaseolus mungo*), green gram (*Phaseolus radiatus*), cow peas (*Vigna catiang*), sesame (*Sesamum indicum*), ground nuts (*Arachis hypogaea*), and castor (*Ricinus communis*), is always grown in the same fields along with the main food crops, the harvesting of *Eleusine coracana* and *Andropogon sorghum* in the middle of December does not deprive the gerbilles of their food. The other plants continue to provide for them till the end of January, when the harvesting of all the crops is completed. Cannibalistic remains are also common in the stomachs of a few well-grown adults. Insects are always found mixed with the other items of food. The animals show an increase in body weight and they appear to accumulate fat around the internal organs.

March to May:

These are the hottest months of the year; the fields are bare and there is a general shortage of food in the neighbourhood. The gerbilles readily take to an omnivorous diet during this season and miscellaneous unidentifiable items of the stomach contents increase. Scattered seeds are available in the fields till the end of March and early April, after which period the main items of food include the rhizomes of grasses and insects. Most insects were so finely masticated that their identification was impossible.

Economic Considerations

Records available for a number of rodents show definite trends in population fluctuations which exhibit a periodic or cyclic change. Most of the apparently periodic fluctuations in year-to-year populations of mammals occur with either a 3/4-year rhythm or a 10-year rhythm.

It has been pointed out by Errington (1951) that the number of animals in a population are the result of a number of factors . . . 'Important in the regulation of numbers of a wide variety of vertebrates may be inter- or intra-specific competition or the density factor, plant succession, human land use, climate, lethal emergencies, epizootic diseases and uncompensated predation including that frequently taking the form of hunting pressure by man. In addition to these some investigators, myself among them, think that a probable extra mundane factor may affect living things in an essentially periodic manner. Population impacts of at least the better defined of these factors vary with the species, time and place.'

Cyclic fluctuations of populations have been demonstrated by Elton (1942) in voles and mice, Dymond (1947) in the animals of Canada, Siivonen (1948) in the mammals of the Northern Hemisphere, McLeod (1950) in the muskrat of Manitoba and Errington (1951) in the muskrats of South Dakota and Northern Minnesota. In such a cyclic fluctuation of populations peaks and depressions of abundance alternate regularly.

The considerable increase or decrease in numbers of a population of rodents in an area has its effect on the extent of destruction to crops in the neighbourhood. In our country, and specially in Mysore State, such a study of population fluctuations of rodents has not been carried out systematically, hence no figures of economic losses to crops due to rat damage are available. The absence of general information of such a type appears to be due to the rather sporadic nature of the damage caused and also to its restriction to localised areas, and finally to variations in annual incidence of damage, the effect being felt only during the years of heavy destruction.

In spite of their capacity for destruction, the gerbilles do not appear to exert much adverse influence on the environment. One of the earliest references to an extreme effect of gerbille infestation is by Blanford (1891) who states that 'in 1878-79 they ravaged the grain fields in the Deccan throughout several thousand square miles cutting down jowari (*Holcus sorghum*) and bajri (*H. spicatus*) stalks and feeding on the grain, part of which they stored in their burrows'. It is probable that this period marked a peak in the abundance of gerbilles in a cycle, which is not definitely established at present.

While the damage to food crops caused by the gerbilles is to be admitted, it seems possible that they are to a small extent beneficial to the farmer. By destroying large numbers of cut-worms (*Laphygma exigua*) and (*Euxoa sagetum*) and other caterpillars, namely *Stenachria elongella*, *Sphenarches caffer*, *Heliothes obsoleta*, and *Exelastes atomosa*, which are inimical to ragi and other mixed crops, they help the farmer to keep down the numbers of these harmful types. Also by feeding on rhizomes of a variety of grasses and other pestilential weeds they must exert a beneficial influence.

SUMMARY

It seems clear that there is a seasonal variation in the foods eaten by the gerbilles through the year. Seeds form a predominant food in December, January, February and to a lesser extent in June and July at the sowing season. In the hot weather period of April and May, and in the months of August and September, rhizomes of a variety of grasses form an important item of food. Insects are eaten in considerable numbers consistently in all the seasons. Miscellaneous food items include remains of smaller gerbilles, a

result of cannibalism. This is specially noticeable during October, November, December and January, when the younger animals leave the parent burrow and establish new homes. The gerbilles also consume cutworms and harmful caterpillars inimical to crops and thus, perhaps, help in their control. By feeding extensively on rhizomes of a variety of grasses and other pestilential weeds they are of some help to the farmer in considerably reducing the cost of weeding operations.

ACKNOWLEDGEMENT

This study was undertaken with the aid of a liberal financial grant from the Education Ministry, Government of India. My thanks are due to Dr. B. R. Seshachar, Professor of Zoology, Central College, Bangalore, for valuable guidance and encouragement, and to Sri B. S. Doddashankarappa who kindly provided facilities for collection of the gerbilles from his estates.

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THE WHALE SHARK, *RHINEODON TYPUS* (SMITH)

BY

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(*With two plates*)

Several years ago, when visiting the 'shrine' of that great entomologist M. T. R. Bell at Karwar, I walked in on him just as he had finished reading one of my articles in the *Journal.* After the usual greetings, the old man turned on me jockingly and said, 'I don't believe you, McCann.' 'Don't believe what?' I replied, not knowing what he was referring to. 'What you have written.' The retort was spontaneous: 'It is the privilege of doctors and scientists to disbelieve each other—even themselves.' We understood and laughed heartily. This is the spirit in which I now write this short article on a 'monstrous' subject.

In a recent issue of the *Journal* (Vol. 51, p. 879) Dr. E. W. Gudger published an interesting article entitled, 'What ultimately terminates the life-span of the Whale Shark, *Rhineodon typus?*' I do not intend to answer this question, for I just do not know. However, there were certain aspects in the life of the Whale Shark which interested me. My limited experience with these giant fish and the views of some writers on the subject were not quite in accord. Having had occasion to cast one, and 'wallow' in the 'innards' of two young males landed in Bombay (1938 and 1940)[1] my hand flew to the hilt of my 'sword' on reading the above-mentioned article. But, I must confess that I feel diffident to cross swords with so great an authority on 'fishy' matters as Dr. Gudger. I merely question rather than attack.

The substance under the first sub-heading in Dr. Gudger's article, 'The only animate enemies of the Whale Shark—intestinal parasites', I must pass over; I found none—I did not look for any. However, the next sub-heading calls for some comment. Great size certainly reduces the enemy cycle of such animals that possess it, but it must be remembered that they all had small beginnings, and that the 'big fellows' only became big fellows at the expense of their less fortunate companions when they were all smaller and younger together! This is paralleled on land by the elephant which, in adult life enjoys a certain amount of immunity from predators. Perhaps, there is a weakness in my comparison for there is nothing known of the life-cycle of the aquatic giant in its infancy. However, some authors refer to schools of adults and, if this is true of the adults, there is good reason to believe that the young also band together, just as many young fish do. All I intend to convey is that the predators take advantage of the giants during their early life and those that have reached the proportions of giants are comparatively immune from predators.

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[1] For a full account of these specimens see *JBNHS*, **42**: 255.

Turning to the second immunity factor referred to by Dr. Gudger, namely, the thickness and density of the skin, I can only rely on my experience with the two young specimens already referred to. The shagreen-covered skin was certainly tough to pierce with a large surgical scalpel but, once an incision was made, I experienced no difficulty in carrying on the cut. Incidentally, as is the case with most animals, the skin of the dorsal surface is somewhat tougher than that of the ventral. Speaking from memory, the tough outer skin was scarcely 3 to 4 mm.[1] thick (see plate IV). Below this tough envelope, cutting was easy. There was scarcely any difference between cutting through the skin of one of these giants and that of any big shark. To carry the comparison yet further, I have since had the opportunity of dissecting a Sunfish (*Mola mola*). The difference in the texture and toughness of the two is considerable. In the one instance it is like cutting through tough canvas, and in the other, through several layers of tough cardboard! Incidentally, I used the same knife on the two species. With the same scalpel, I got down to the heart without much difficulty. The heart is still in my possession. I have laboured this point just in order to show that these giants are not so tough as they appear to be. In the circumstances, I feel that the skin plays little, if any, part in protecting these monsters against well-armed predators. The giants, nearing maturity, have passed the stage of attack from their earlier enemies, just as adult elephants pass the stage of attack from large carnivora.

That mutilated specimens showing the attacks of predators are seldom, if ever, encountered or washed up is not surprising for, once the skin is torn, the flesh being comparatively soft, would soon be demolished by smaller flesh eaters and scavengers, in which the sea abounds. Accordingly, I agree that *size* plays an important part in survival, but not entirely. The effectiveness of the skin, as a protective armour is seriously open to question.

On the subject of food, Dr. Gudger believes that the Whale Shark is largely a surface-feeding plankton-gulper; of similar habit to the large baleen whales. Apparently, his belief is based on the observations of others, for, in support, he quotes Mr. E. R. F. Johnson: 'They (the sharks) were plainly engaged in feeding, swimming about for one or two minutes with the wide mouths partly open, the upper jaw being about even with the surface of the water. Then each fish would close its mouth and dive to a shallow depth, for the depth pressure to help to get rid of the water through the gills; and then the giant fish would come to the surface for another swim with mouth open.' Perhaps, this statement could be interpreted in quite another way. The opening and closing of the mouth was probably the normal 'fish-fashion' procedure of oxygenating the gills, and the occasional sounding to accelerate the flow over the gills.[1] Such bulk, in spite of its sluggish habits, would require an enormous amount of oxygen to maintain itself. Accordingly, the original observation could be a misinterpretation, more so, as there are no stomach contents to support the statement. Again, I believe that surface plankton is comparatively scarce during the hours of daylight, and it is only at its maximum during the hours of darkness. However, depending on the season, there would be a considerable amount of drifting algae, with its attendant life, at the surface, which could be engulfed.

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[1] The puckered skin is well illustrated in the accompanying photograph.

Towards the end of his section on the feeding habits of these giant fish, Dr. Gudger refers to reports from waters north of Cuba of Whale Sharks feeding in a *vertical position.* Again, a Mr. Stewart Springer had actually seen sharks feeding in the Gulf of Mexico in such a position. This posture during feeding, Dr. Gudger refers to as 'variant feeding'. Strangely enough, Dr. Gudger does not refer to the stomach contents of the only specimen which he had been fortunate enough to see in the flesh.

The two young males, which I had the opportunity of examining, were captured by fishermen in their nets and towed ashore. Neither of them was a diseased nor a disabled specimen. The stomachs in both the individuals were packed to capacity with marine algae. The algae were so fresh that there could be little doubt that the meal was very recent—the animals must have been feeding at the time of capture and blundered into the nets. Likewise, there can be little doubt that a certain amount of both micro- and macro-plankton may enter the capacious mouth along with the vegetation, but that is perhaps more accidental than deliberate. In the case of both individuals examined, no fish were observed among the stomach contents. This is all the more surprising when we consider that the animals were captured at the fishing grounds, and in fishing nets that were set for smaller fry. Under the circumstance it would not appear rash to conclude that the Whale Shark is predominantly a true vegetarian. Nevertheless, let us look further for some more evidence in support of this view.

A casual examination of one of these enormous fusiform giants seems to suggest that their shape has an important bearing on their manner of feeding. The greater bulk of their mass is concentrated towards the head, a factor of distinct advantage for sounding. Again, the terminal mouth would be of equal advantage whether they fed at the surface, or while sounding, in a vertical position as described by Springer.

The numerous rows of rasp-like teeth, quite unsuitable for holding active prey, seem admirably adapted for browsing on slime-covered algae. The closely pectinate gill-rakers, believed to be adaptations for sifting out the zoo-plankton engulfed while feeding, could be equally effective in expressing the water from the mouthful of algae. The gill-rakers would prevent the slimy laminae of the algae from getting among the gills themselves and, perhaps, fouling them. Speaking from memory, the gill-rakers appeared to be covered by highly, vascular tissue and, besides performing the duty of a protecting sieve for the gill-chambers, is it not possible that they perform the function of ancillary gills also? However, this last point is an afterthought and requires confirmation.

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[1] In fish with subterminal mouths the action of the mouth would not be readily visible.

We have still to explain the surface haunting habits so often observed. Both the young males were caught at night. This may suggest that the animals normally feed at night (?), and surface during the day, there to leisurely swim about, and bask in the sun, contentedly digesting the vast amount of algae eaten. Similar behaviour is met with among herbivorous land mammals, such as the ruminants, which feed by night and lie up during the day digesting their enormous meal of cellulose.[1] Another consideration which may not be out of place is that the surface water normally contains a higher volume of oxygen than the deeper layers; this fact alone would facilitate the respiration of such a monster and, at the same time, the warmer temperature of the surface and the procumbent posture would go a long way in aiding digestion of the vast meal. In addition, there appears good reason of believe that a herbivorous diet often tends to produce larger body form than does a carnivorous diet. This is equally true of the animals of the past as of the present day. Whales, however, seem to be the exception, but this exception may be largely due to the type of food (not herbivorous) and the manner necessary for capturing and feeding on such a diet. The head of a baleen whale is converted into an enormous 'trap', and the diet is rich. It is significant that the more aggressive and carnivorous cetaceans are also of small size.

Another feature of the Whale Shark, perhaps worthy of mention, is its apparently placid temperament. Apparently, this is also in keeping with its vegetarian diet. This too is paralleled by herbivorous land mammals. Not so long ago, I happened to see a film in which an aqualung diver had the courage to clamber over the head of a Whale Shark and to peer into its cavernous mouth. The shark did not seem in the least bit disturbed by this adventurous human. However, this is speculation, so let me pass on.

The habit of the Whale Shark of leisurely drifting at the surface has undoubtedly given rise to the widely accepted assumption that it is mainly a zoo-plankton feeder, but there is little or no evidence to support this view based on actual examination of the stomach contents. As early as 1870 Wright recorded large masses of algae as the stomach contents and he concluded that the animal was herbivorous. The repeated finding of large quantities of algae as the main stomach contents does not appear to be *merely accidental*!

Soon after reading the great epic of the Kon-tiki, I had the pleasure of meeting one of its crew, Bengt Danielsson. A passage from the book, dealing with the Whale Shark encountered, raised several questions in my mind and here was the chance of getting some of them cleared up. The passage is as follows: 'and a toad-like jaw which was four or five feet wide and had long *fringes hanging drooping from the corners of the mouth*.'[2] Were these *fringes* algae? The behaviour of the animal, as described, appeared (to me) as though the animal were possibly feeding on the algae which had developed on the logs composing the raft. In reply to one of my questions, Mr. Danielsson informed me that quite a considerable amount of algae had formed on the logs. This then seems to be what the animal was after to have spent so much time about and under the raft. Evidently, it was browsing, and, perhaps, the *fringes* can be explained. If this were so, it seems we have some evidence that the animals feed on algae drifting at or near the surface. Mr. Danielsson confessed that *he* was not very pleased with the proximity of the great beast at the time, in spite of its placid nature!

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[1] I am aware of the other factors involved also.

[2] The italics are mine.

A further argument that these sharks are vegetarians centres round their seasonal migration, particularly their periodicity and location along the coasts of India. Writers on the Whale Shark have gone to some length to account for the movements of these fish in relation to the appearance of off-shore phyto- and zoo-plankton, and the trend of ocean currents. Although these factors play an important indirect part, the main seasonal movement appears to be coupled with the first two principles of life—*preservation* (feeding) and *procreation* (breeding). Either one or both factors may cause animals to change their immediate habitat. This is common to most life in the broader sense, and is well known. However, it often happens that in our enthusiasm to fathom the unknown we lose sight of the obvious! This reminds me of a story told me by a French biologist. A professor was making an exhaustive study of the uses of the leg. After considerable research, he went in great glee to his colleague and said, 'Professor! Professor! I have discovered forty-nine uses of the leg.' 'Let me see,' said the other. After perusing the list, he turned to his companion and said, 'Ah! but, my dear colleague, you have forgotten one'. 'Which one?' came the sharp reply. 'The *natural* one—walking!'

I do not intend to deal with this aspect of the Whale Shark's life-cycle in great detail, but merely to make brief references to some of the more probable factors controlling its movements, as they present themselves to me. My observations are based mainly on the belief in the vegetarian diet of these great fish. Their appearance along the Indian coasts, particularly along the western coast, between certain months of the year (January to April) seems to be very significant. It coincides with the annual increase of the algal vegetation along the coastline. That the trend of oceanic currents at that particular season of the year influences and assists migration, goes without saying, but it appears to me that the main influence is the abundance of marine algae (food). At the time when the fish are moving westward (January to April), the Bay of Bengal is under the influence of the north-east monsoon. The great rivers emptying into it carry down enormous volumes of freshwater and sediment in suspension. The sediment in suspension may be seen far out at sea. The dilution of the waters of the Bay and the large amount of sediment are factors detrimental to the growth of marine algae. Hence, food is scarce, and there would be no incentive for the animals to travel up the Bay, apart from the muddy condition of the

PLATE I

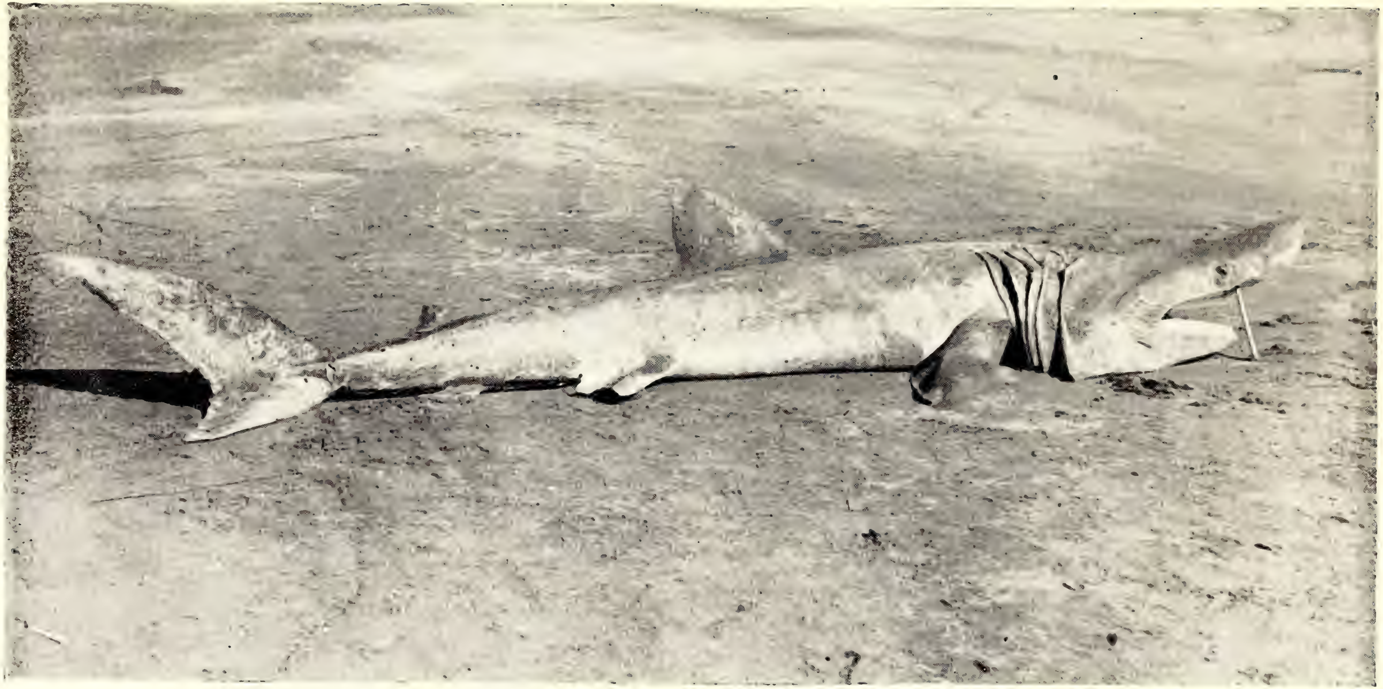
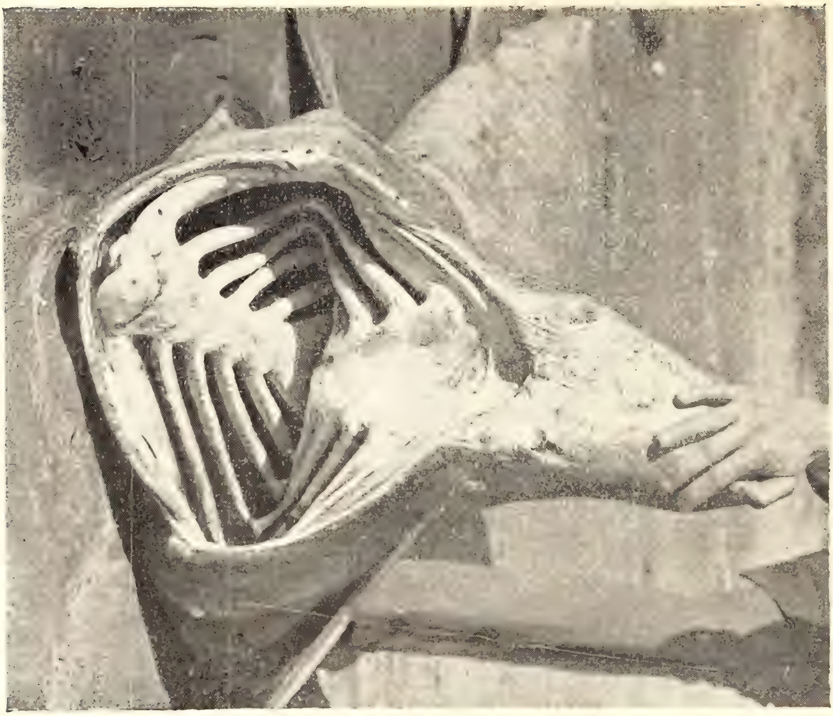


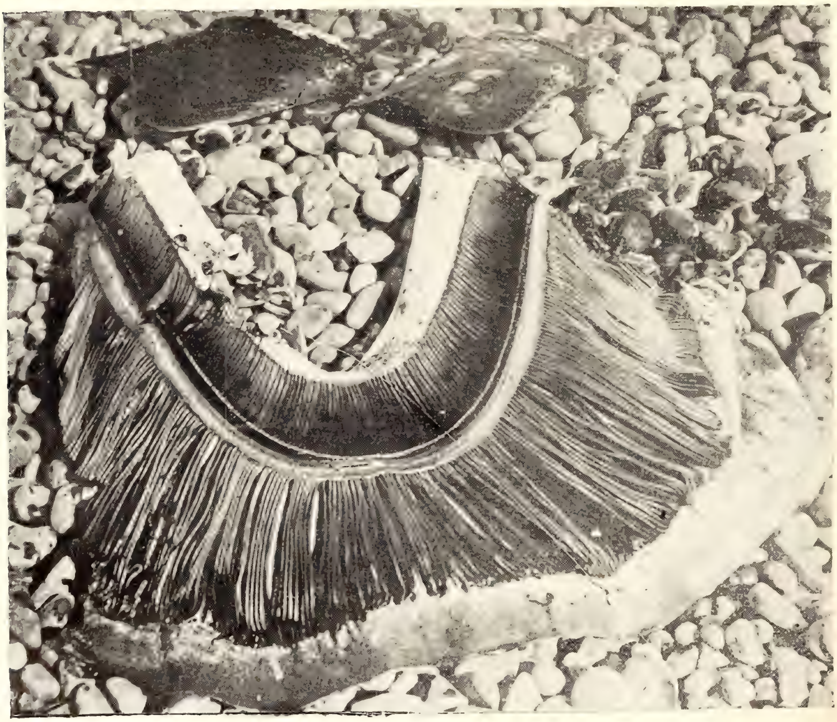
Photo: J. T. Salmon *Courtesy Dominion Museum Wellington, N.Z.*

The Basking Shark (*Cetorhinus maximus*)

THE BASKING SHARK (*Cetorhinus maximus*)



A. Showing gill arches and reduced tongue.



Photos: J. T. Salmon *Courtesy Dominion Museum Wellington, N.Z.*

B. Gill arch with gill and gill rakers.

water and lower density. That an occasional stray may enter the upper reaches of the Bay in no way negatives this conclusion.

When the north-east monsoon is in progress, the western coast of India is normally free from heavy rain. Excepting the Indus, no large rivers empty into the Arabian Sea. Soon after the cessation of the south-west monsoon, which brings heavy rain to the west of India, the coastal waters clear, and there is a marked increase in algal production. The inter-tidal zones are remarkably productive, and large quantities of the algae are swept out to sea by wave and tidal action. There is a corresponding increase in the deeper water forms during this period. About March, each year, the inter-tidal algae commence to die out. By May, the monsoon swell commences and the sea often becomes boisterous and churns up the coastal waters.[1] This action of the sea, shortly to be followed by the monsoon rains, coupled with the sediment in suspension, reduces the amount of the deep water algae. Thus again, there is a scarcity of food and the sharks move off to 'greener' pastures.

In Vol. 42, p. 255 of the *Journal*, Mr. S. H. Prater gives us an informative article dealing with the distribution of the Whale Shark in the Indian waters. The article is well illustrated and worthy of careful perusal. Mr. Prater goes to some length in an effort to explain the seasonal migration of these animals and arrives at the conclusion that their movements are dependent on the movements of oceanic currents and zoo-plankton. This conclusion is mainly based on the assumption that the Whale Shark is largely a zoo-plankton gulper. His view is all the more surprising when he was fully aware of the stomach contents of the 1938 and 1940 specimens, and of the circumstances under which they were captured. In addition, he was also aware of Wright's evidence. Surely, the stomach contents of these individuals were not accidental? The evidence that the Whale Shark is a zoo-plankton feeder is, to say the least, very slender.

I am not familiar with the Basking Shark, *Cetorhinus* (see Pl. I) but from the numerous accounts of the species and some of its anatomical characteristics, it would appear that there is little doubt that it is a zoo-plankton feeder, subsisting largely on shrimp-like crustacea (krill) and other small organism, just as the baleen whales do. The similar habit of drifting or swimming at or near the surface observed in both the Basking and Whale Sharks has, apparently, led to the assumption that the feeding habits and the food are similar, if not the same, in the two species. This assumption I am not prepared to accept for several reasons, not to mention the stomach contents already referred to. In support of my 'disbelief', allow me to compare the two in several details:

(*a*) *Shape*[2]:—If we contrast the shape of the two species it will be noticed that *Cetorhinus* (Pl. I) is far more fusiform and stream-lined than *Rhineodon*. The bulk of the former is more evenly distributed throughout its length than in the case of the latter.

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[1] It is generally believed that sharks are averse to entering turbid water.

[2] The illustrations depicting the shape of *Cetorhinus* in many works are not in strict keeping with its actual shape (i.e. line drawings)!

In *Rhineodon* the greatest bulk of the animal is situated in the fore-part of its body. The snout is more acute and 'compressed' in *Cetorhinus* than in *Rhineodon*; in the latter it is more depressed. Again, if we compare the caudal fins, that of *Cetorhinus* is more in keeping with the fast moving sharks, such as the Mako (*Lamna*), than that of *Rhineodon.* All these factors taken conjointly indicate that the Basking Shark is built for greater speed and activity than the Whale Shark.

(*b*) *Head*:—If we look more closely at the head, apart from the acuteness and obtuseness of the snouts already referred to, the first point which immediately strikes the observer is that the Basking Shark has a *subterminal* mouth and *Rhineodon* a *terminal* one. Further, the angle of the gape in *Cetorhinus* extends far behind the eye, whereas in *Rhineodon* the gape is 'tadpole-like' and terminates in front of the eyes. An obtuse snout and a terminal mouth would be a distinct disadvantage to a fast-moving animal feeding with its mouth open in 'beds' of zoo-plankton (krill and mollusca). The resistance of an open, terminal mouth to the pressure of water as the animal forged forward would tend to reduce speed in such an animal as the Basking Shark whereas, in a slow-moving 'browser' feeding on algae, speed is no consideration. Another point which strikes me most forcibly is the great disparity in the size of the gill-covers in the two species. In *Cetorhinus* the gill-covers almost 'sever' the head from the body (see Plate I), while in *Rhineodon* they are comparatively short. This again, to my mind, is a further indication that the Basking Shark is a faster moving animal than it is believed to be, and that the extensive gill-openings are an adapation to its feeding habits. The large gill-openings would facilitate the rapid flow of water taken in at the mouth along with its food, as it ploughs through the plankton when feeding. Such large openings would lessen the resistance to the water and not hinder the rapid progress of the animal. The mouth in this case is converted into a sure plankton 'trap', specialized gill-rakers confining the catch. It is also significant that the gill-arches reach further forward in *Cetorhinus* (see Plate II A & B) than they do in the Whale Shark. The latter has a large flat tongue, and the gill-arches are not so prominent.

(*c*) *Distribution*:—Lastly, we come to the distribution of the two species. The Basking Shark is an inhabitant of the temperate waters of both the northern and southern hemispheres, whereas the Whale Shark is an inhabitant of the warmer waters of the globe. The Basking Shark, like the baleen whales, is more or less restricted to the areas where the normal food (krill and molluscs) is in great abundance, while that of the Whale Shark coincides with the algal distribution.

Under the circumstances, I believe that the Whale Shark is essentially a herbivorous animal, subsisting on marine algae. Its great size, anatomical structure, habits and normal distribution all go far in confirming this view. There is the substantial evidence of at least three specimens—there is no concrete evidence to the contrary. The only point of similarity between the Whale Shark and the Basking Shark is the habit of leisurely drifting or swimming at or near the surface of the sea. This habit has undoubtedly led to the erroneous assumption that both species are zoo-plankton feeders. Perhaps, the only point of similarity between the two is that both have an equally heavy meal to digest, and this is best done at or near the surface where the volume of oxygen is greatest, a smaller effort required in swimming, a reduced pressure around the loaded stomach, and a more 'comfortable' temperature.

Incidentally, when conducting university students around the galleries, I often contrasted the Whale Shark, with its great bulk and cavernous mouth, with the tiger! The comparison always called forth a considerable amount of laughter and merriment as my audience was more often than not composed of both strict vegetarians and meat eaters! It always went down well without offending the susceptibilities of my hearers, although the joke was invariably against the vegetarians!

PETRELS, SHEARWATERS AND OTHER OCEANIC BIRDS IN THE NORTH INDIAN OCEAN

BY

W. W. A. PHILLIPS

Since the publication in the *Journal* in December 1950 of my paper on 'Wilson's Storm-Petrels, Shearwaters and other Sea-birds in the Gulf of Aden and Indian Ocean', I have crossed the Indian Ocean from Colombo to Aden and back once again, and have been able to make further observations on the oceanic birds of that part of the Ocean that lies between these two ports. The first voyage outwards from Colombo took place in early February 1953 and, as usual at that time of the year in these waters, oceanic bird life was very scarce until we arrived in the vicinity of Socotra and the Gulf of Aden, where shearwaters and phalaropes in small numbers were observed. No small petrel of any species was observed on this voyage. On the return journey in early August 1953, there were no phalaropes, but petrels and shearwaters were plentiful, as expected, and were observed in greater or lesser numbers each day until we entered Colombo Harbour. On this voyage, three Wilson's Petrels (*Oceanites oceanicus*) and one Mascarene Black Petrel (*Pterodroma aterrima*)[1] were caught on deck after dark; they were all released the following mornings after thorough examination. Small white-bellied petrels—believed, in spite of Gibson-Hill's statement (p. 446) that there are no reliable sight records of these species from our area, to have been either the Blackstreaked Storm Petrel (*Fregetta tropica*) or more probably the Whitebellied Storm Petrel (*F. grallaria*)—were fairly plentiful on one day near lat. 10°24′N. and long. 63°25′E. on this voyage.

On our return to Colombo, through the good offices of Mr. D. D. Condon of the United Kingdom High Commissioner's Office I was placed in touch with Mr. G. N. Grisenthwaite, Fishery Expert in trawler '*Braconglen*' which makes regular trips from Colombo to the fishing grounds to the west of Cape Comorin. On his voyages, Mr. Grisenthwaite has made some valuable observations on the oceanic birds—chiefly Wilson's Petrels and shearwaters—that he has encountered; extracts from his notes are given at the end of this paper, including his interesting record of the migration of Wilson's Petrels.

In the following notes from my diaries, I have condensed my observations and confined them to the pelagic birds observed on each voyage.

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[1] Mackworth-Praed and Capt. Grant, in their 'Birds of Eastern and North-Eastern Africa,' Vol. I, call this bird *Bulweria brevirostris*, but Mr. W. B. Alexander informs me that this name appears to be incorrect.

HOMEWARD VOYAGE. M. V. *'Derbyshire'*

(10,625 TONS. E. D. BRAND, MASTER)

Colombo to Aden—February 6th to February 12th 1953

February 6th. 08.45 hrs. Left Colombo Harbour; sunny with slight breeze; visibility excellent.

09.45 hrs. Flock of about 30 Bridled Terns (*Sterna anaethetus*) passed flying south.

12 *Noon Lat.* 7.06 *N. Long.* 79.07 *E. Distance from Colombo* 43 *miles; average speed* 14.33 *knots.*

12.10 hrs. Single tropic-bird (*Phaethon* sp.) flew past and vanished astern; it flew very rapidly at varying heights from just above to 100 ft. or more from the water.

14.30 hrs. to dusk. Visibility excellent; no other birds seen.

February 7th. Indian Ocean.

06.00 hrs. to Noon; flat calm; no wind; no birds.

12 *Noon. Lat.* 08.04*N. Long.* 73.03*E. Distance run* 370 *miles; average speed* 15.10 *knots.*

12.05 hrs. Passing Minicoy, distant about 15 miles; two solitary Frigate Birds (*Fregata* sp.) far away to south.

14.00 hrs. to dusk. Visibility excellent; no birds seen.

February 8th. Indian Ocean.

06.15 hrs. to Noon. Bright, sunny; slight breeze; visibility excellent. No birds seen.

12 *Noon. Lat.* 09.11*N. Long.* 66.51*E. Distance run* 376 *miles; average speed* 15.35 *knots.*

Afternoon to dusk. No birds seen.

February 9th. Indian Ocean.

06.10 hrs. to Noon. Bright and sunny; slight breeze; visibility excellent; no birds seen.

12 *Noon. Lat.* 10.12*N. Long.* 60.57*E. Distance run* 376 *miles; average speed* 14.53 *knots.*

to 16.30 hrs. Visibility excellent; no birds seen.

16.44 hrs. to 16.55 hrs. Two tropic-birds appeared and flew together, round and over the ship, for about 10 minutes; they seemed to be Indian or Smaller Redbilled Tropic-bird (*P. indicus*).

17.20 hrs. to dusk. Two tropic-birds again flying round the ship; either the same two as seen before or a fresh pair; they were seen in a good light and were undoubtedly Indian Tropic-birds. No other birds seen before dusk.

February 10th. Indian Ocean.

06.10 hrs. Sea smooth, very slight breeze, visibility excellent.

06.15 hrs. to *Noon.* A tropic-bird appeared from over our bows and spent the next 15 minutes flying rapidly round and over the ship; it generally flew some 100 to 150 ft. above the sea, shook itself several times and spread its tail when banking to turn sharply; beak yellow, tail short with black tips to white feathers; black and brown on wings and upper parts; probably a juvenile Indian Tropic-bird (*P. indicus*). No other birds seen.

12 *Noon. Lat.* 11.18*N. Long.* 54.49*E. Distance run* 369 *miles; average speed* 15.07 *knots.*

to 15.30 hrs. Visibility excellent; no birds.

15.50 hrs. Single, medium-sized shearwater (*Puffinus* sp.) flying low over water in usual shearwater manner, a long way out on port side; appeared to be dark brown all over.

16.20 hrs. Another solitary shearwater of same species.

16.55 hrs. Another shearwater, closer to starboard; dark brown all over but rather darker on the upper parts; we are now about 60 to 70 miles south of Socotra and appear to have entered the habitat of a resident species of shearwater which looks very like the Wedge-tailed (*Puffinus pacificus*).

17.10 hrs. Another shearwater of the same species; dark brown in colour with rather long, pointed wings.

17.40 hrs. Party of 4 phalaropes (*Phalaropus* sp.) flying rapidly west close over the water, twisting and turning with the sun lighting up their white under parts. Another dark brown shearwater. Islets off the south of Socotra are now in sight about 30 miles to northwards.

February 11*th.* Gulf of Aden.

05.30 hrs. to 06.15 hrs. Bright sunny morning; wind steady from NE.; slight breeze and swell; visibility excellent. African Coast is in sight to port.

06.20 hrs. Solitary phalarope crossed our bows flying south.

06.30 hrs. Tropic-bird in distance.

07.40 hrs. Two shearwaters crossed our bows flying rapidly northwards; light excellent; both were very dark sooty brown above and only a little lighter below; wings long and pointed, tail also longish and rather pointed; they appear to be Wedgetailed Shearwaters (*P. pacificus*).

08.10 hrs. A smaller species of shearwater, white on the lower parts, flying some distance away on the port bow. Five phalaropes crossed our bows, flying close over the sea towards the African coast.

08.55 hrs. Dark brown shearwater followed by a smaller species with white under parts; the second one would appear to be the Persian Shearwater (*P. lherminieri persica*) which is well-known to be resident in these waters.

09.50 hrs. to 10.30 hrs. 4 dark brown shearwaters (*P. pacificus* ?) crossed our bows, flying N.

10.40 hrs. Another dark brown shearwater crossed our bows flying N; this one flew close to us and was almost certainly a Wedgetailed Shearwater.

12 *Noon. Lat.* 12.17*N. Long.* 48.53*E. Distance run* 354 *miles; average speed* 14.44 *knots.*

15.05 hrs. Single phalarope and single dark brown shearwater passed flying low over water.

15.12 hrs. Another solitary phalarope appeared close to our port bow. It flew a little distance and settled on the water for a minute or so; it rode very upright with the neck held straight up. In appearance, it was a small white bird with a blue grey back; in flight the white wing bar is very noticeable; all seen have flown close over the water with the sun glistening upon them; they give the impression of small white and bluish grey birds. Probably the majority of them are Rednecked Phalaropes (*P. lobatus*) but some of them may be the Grey Phalarope (*P. fulicarius*); it is most difficult to identify the species, with any certainty, from the deck of a liner.

15.15 hrs. to 15.30 hrs. 4 dark brown shearwaters passed, flying singly; one settled on the sea directly in our course; it took to flight and wheeled off as the ship approached; all these shearwaters are rather slim birds with long pointed wings and longish, rather narrow tails.

15.35 hrs. Two more phalaropes flying E., followed by another dark brown Shearwater 500 yds. to port.

16.18 hrs. A Persian Shearwater wheeling to port, the sun glistening on its white under parts.

16.40 hrs. Two more phalaropes.

17.00 hrs. Two tropic-birds, flying round ship; both appeared to be Indian Tropic-birds (*P. indicus*) with long white tail streamers.

17.25 hrs. Another solitary phalarope passed.

We entered Aden Harbour during the night. It will have been noted that, with the exception of the phalaropes, the frigates, and the tropic-birds only two species of shearwaters were seen and no other petrels at all. As the voyage took place during early February, when normally all Southern Hemisphere nesting birds, i.e. the migratory petrels and shearwaters, would still be in southern latitudes, this is exactly what one would expect. Whenever I have passed through the Gulf of Aden and waters adjacent to Socotra, I have invariably observed two species of shearwaters, one moderately large and dark which I believe to be a race of the Wedgetailed Shearwater (*P. pacificus*) and the other smaller, sooty black above and white below, which I was misled in my former paper into calling the Dusky Shearwater (*P. assimilis*) but which now appears to be the Persian Shearwater (*P. lherminieri persica*). There cannot be any doubt, I think, that both these shearwaters are resident in these waters, all the year through; presumably they breed in Socotra and/or the adjacent islets. I have given by diary in full with regard to the sighting of these shearwaters in order to show their density in these waters. Phalaropes are always present around Socotra and in the Gulf of Aden during the winter months; I have seen many of them but almost always on the wing; I believe most of them are the Rednecked Phalarope (*Phalaropus lobatus*) but some of them may be the Grey Phalarope (*P. fulicarius*). I am not sufficiently familiar with the two species to be able to distinguish them on the wing at a distance.

My return voyage took place during early August while the Southern Hemisphere shearwaters and petrels were still in their northern haunts; many more oceanic birds were, therefore, to be observed in the Indian Ocean. On this voyage I had the pleasure of the company of Mr. D. D. Condon of Colombo who spent many hours bird-watching with me.

OUTWARD VOYAGE. *M. V. 'Derbyshire'*

(10,625 TONS. E. D. BRAND, MASTER)

Aden to Colombo: August 4th to August 10th 1953

August 4th. Gulf of Aden. Left Aden about 08.10 hours.

09.15 hrs. One Wilson's Petrel and 20 to 30 Large Crested Sea-terns (*Sterna bergii*) passed. Wind strong from S.; slight swell and a little choppy; visibility fairly good with some distant haze.

09.20 hrs. Liberated Wilson's Petrel which had been caught on deck about 20.30 hrs. the evening before. This petrel has a subdued double call-note like a child's squeaker; it was a very gentle bird and did not struggle to escape.

11.20 hrs. Several Wilson's Petrels, all flying independently close over waves; none in wake.

11.45 hrs. to Noon. Large numbers of Wilson's Petrels flying across our bows and in lee of ship, 100 yds. or so port; several hundreds in sight at one time. Often they paddle and feed on the water.

12 *Noon. Lat.* 12.43*N. Long.* 45.50*E. Distance from Aden* 53 *miles; average speed* 14.95 *knots.*

12.15 hrs. Still many Wilson's Petrels to be seen.

12.30 hrs. Small numbers of Wilson's Petrels still about but large concentrations, as seen between 11.45 to 12.15 hrs., now passed. All these petrels appeared to be Wilson's (*Oceanites oceanicus*).

12.45 hrs. Still many Wilson's Petrels; one shearwater, black and white, passed some distance away.

13.45 hrs. Many Wilson's Petrels crossing bows, flying southwards and in lee of ship.

15.00 hrs. 100 to 150 Wilson's Petrels now in our wake; they look like a swarm of immense bees; small numbers flying across bows and to leeward.

15.10 hrs. Small sooty brown shearwater seen by Mr. Condon.

15.37 hrs. Single, rather small, blackish shearwater crossed our bows flying S.

15.45 hrs. Three Brownwinged Terns (*Sterna anaethetus*), beating S. against strong wind, crossed our bows; Wilson's Petrels still plentiful. Sea very choppy with moderate swell and confused waves; sunny with some cloud; visibility excellent.

16.00 hrs. to 16.45 hrs. 200 or more petrels in our wake, flying to and from across the smoother water; all appear to be Wilson's.

17.30 hrs. Still hundreds of Wilson's Petrels in our wake and many flying round ship; they remained until it became too dark to see them properly. Small numbers (about 12) Brownwinged Terns flying S.

August 5th. Gulf of Aden (approaching Socotra).

05.50 hrs. Some swell but no breaking waves; sky overcast; light breeze; visibility good with horizon hazy.

06.00 hrs. Passed 'rafts' of several hundreds of Wilson's Petrels; many on water, others taking wing and flying off presumably to feed; none in wake. On other voyages also I have observed large rafts of these petrels on the water in the very early morning; apparently they collect to spend the night sleeping and preening on the water and disperse as soon as it is light, to commence feeding again.

06.10 hrs. Straggling flock of 100 or more Wilson's Petrels crossed our bows; many others in various directions around us.

06.15 hrs. Small black and white shearwater, probably Persian; many Wilson's Petrels, one or two in our wake.

07.30 hrs. to 07.50 hrs. One smallish sooty black shearwater and several Wilson's Petrels passed but comparatively few about now.

07.55 hrs. Two smallish sooty black shearwaters flying near bows; longish tail, shortish black beak; too small for Wedgetailed Shearwaters, may be Mascarene Black Petrels (*Pterodroma aterrima*).

08.00 hrs. to 08.45 hrs. Small number of Black Petrels (?) and one or two Wilson's Petrels; Black Petrels (?) fly like small shearwaters.

08.50 hrs. to 09.30 hrs. Swell increasing and sea choppy; sky overcast. Small numbers of Black and Wilson's Petrels passed; none in wake.

10.07 hrs. Tropic-bird reported flying round ship; no petrels.

10.45 hrs. Solitary blackish shearwater—probably Mascarene Black Petrel.

11.08 hrs. Single Wilson's Petrel.

11.55 hrs. Two Black Petrels (?) crossed our bows flying S; we are now about 25 to 30 miles from land.

12 *Noon. Lat.* 12.53*N. Long.* 51.57*E. Distance run* 358 *miles; average speed* 15.24 *knots.*

Confused and choppy sea; strong wind from S; overcast, with weak sunshine at times; visibility good but haze in distance.

13.40 hrs. to 13.55 hrs. Tropic-bird near bow; 5 Black Petrels (?) all flying independently, crossed bows flying S.

14.54 hrs. Persian Shearwater (*P. lherminieri persica*), small, black above white below, crossed flying S., followed by a Brownwinged Tern (*Sterna anaethetus*).

15.00 hrs. Two Wedgetailed Shearwaters (*P. pacificus*), very much the same colour but larger than the Black Petrel (?), crossed flying N.

15.05 hrs. 5 or 6 Black Petrels (*P. aterrima*?) flying to port.

15.15 hrs. 3 or 4 Persian Shearwaters and 4 or 5 Black Petrels (?) flying ahead.

15.30 hrs. to 15.40 hrs. Many Black Petrels (?) flying in various directions, usually solitary, with a few Persian Shearwaters and one Indian Tropic-bird (*Phaethon indicus*).

15.45 hrs. Large dark sooty shearwater crossed our bows flying S.; its flight was more gull like; it plunged once into the water; wings longer and sharper than in Black Petrel (?) and had more flapping flight—unidentified.

16.28 hrs. Several Persian Shearwaters, Black Petrels (?) and one Brownwinged Tern crossed, flying S.

16.32 hrs. Another Indian Tropic-bird circled the ship; small numbers of Black Petrels (?) and Persian Shearwaters passing.

16.50 hrs. Many Persian Shearwaters, many Black Petrels (?) and one tropic-bird passing.

16.55 hrs. Still many Persian Shearwaters and Black Petrels (?). Socotra is now in sight on starboard bow.

17.15 hrs. to 17.30 hrs. Small numbers of Persian Shearwaters and Black Petrels (?).

17.40 hrs. Black Petrel (?) settled on water, consuming something; three birds looking like Nodies (*Anous stolidus*) crossed flying S.

18.10 hrs. to 18.30 hrs. (Dusk) Another Indian Tropic-bird passed; Black Petrels (?) numerous, Persian Shearwaters in smaller numbers; we are now in the lee of Socotra, distance 20 to 25 miles; sea fairly calm; visibility good.

August 6th. Indian Ocean.

06.15 hrs. to 06.30 hrs. Shortly after sunrise; strong wind from SW.; heavy monsoon swell, choppy sea; visibility very good. No birds.

07.50 hrs. Solitary Black Petrel (?) crossed, flying N.

08.55 hrs. Black Petrel (?) crossed flying S.

09.05 hrs. Another Black Petrel (?) flying S., very rapidly.

10.25 hrs. to 11.30 hrs. Black Petrel (?) flying N.; Black Petrels (?) were seen at the rate of about one every 15 minutes, mostly flying across the wind, northwards.

11.35 hrs. to Noon. No birds.

12 *Noon. Lat.* 12.04*N. Long.* 57.44*E. Distance run* 346 *miles*; *average speed* 14.73 *knots.*

Sea and wind have moderated slightly but typical SW. Monsoon conditions prevail; sunny; visibility good.

to 13.00 hrs. No birds.

15.00 hrs. to 16.30 hrs. No birds seen.

16.37 hrs. to dusk. One Black Petrel (?) crossed, flying S.; another about 17.00 hrs. and a third about 18.00 hrs.

20.30 hrs. Mascarene Black Petrel (*Pterodroma aterrima*) came aboard; it knocked against one of the lights on the Sports deck and was brought to me.

Description and Measurements. Upper and lower plumage sooty blackish brown with a few grey feathers on abdomen near vent; small, darker patches immediately in front of eyes; legs and webs dusky flesh with a yellowish tinge when first caught; outer toes and webs more dusky and inner more flesh coloured; nails jet black, small and sharply curved; beak short and black. Wing 257 mm.; beak to gape 34 mm.; culmen 29 mm.; tarsus 37 mm.; eye dusky black. This specimen confirms the identification of the numerous blackish, shearwater-like birds, too small and slim for Wedgetailed Shearwaters, seen during the past three days. When close, the small, shorter beak is a good distinguishing character but often, when the bird is a little distance away and there is nothing with which to gauge its size, it is difficult to distinguish it from the Wedgetailed Shearwater. This bird was liberated the following morning, after some Mallophaga parasites had been removed from it; it was in fresh, unworn plumage.

August 7th. Indian Ocean.

05.50 hrs. to 06.10 hrs. Moderate swell, little choppy; moderate to light breeze from SW.; visibility good; 6 dark, medium-sized shearwaters crossed, flying independently, some distance away; seemed to be either Wedgetailed Shearwaters or Black Petrels.

06.15 hrs. to 07.07 hrs. Small numbers of medium-sized, dark shearwaters crossing, flying S.; mostly too far for certain identification.

07.20 hrs. to 07.40 hrs. Indian Tropic-bird ranged up on starboard side, flew round and dropped astern; 2 Mascarene Black Petrels flying independently to port.

07.45 hrs. to 08.00 hrs. Many dark, shearwater-like birds passed, mostly flying S.; majority appeared to be Mascarene Black Petrels but some of them, which seemed rather larger and more stoutly built, were probably Wedgetailed Shearwaters. One small petrel, rather far off, appeared to have white underparts.

08.15 hrs. to 08.55 hrs. Two small petrels passed closer to port; they definitely have white underparts; they glide more than Wilson's, are about the same or a little smaller in size, have dark wings and white rumps. Several Mascarene Petrels continue to pass but large flights appear to be over.

09.25 hrs. Three Sooty Terns (*Sterna fuscata*) flying high, southwards; 3 more Macarene Black Petrels and one small petrel with white underparts.

09.32 hrs. Two more Black Petrels.

09.35 hrs. 16 Sooty Terns, flying high, crossed our bows flying southwards; 5 minutes later a large, straggling flock of 30 followed them.

09.40 hrs. Indian Tropic-bird passed.

09.45 hrs. Another Mascarene Black Petrel and another white-bellied petrel.

10.37 hrs. to 10.50 hrs. Several Mascarene Black Petrels crossed our bows, flying N.

10.54 hrs. 2 medium-sized, dark shearwaters, larger and more heavily built than Black Petrels; wings are wider and beak longer; there is little doubt that these are Wedgetailed Shearwaters (*P. pacificus*). Possibly some of those seen earlier were also of this species.

11.03 hrs. 2 more white-bellied, white-rumped small petrels crossed our bows close in; they could be well seen; tail is almost square; wing-lining white, belly white, chest and throat black, rump white; they answer well to the description of the Whitebellied Storm Petrel (*Fregetta grallaria*). I suspect that they are of this species, but possibly they might be the Blackbellied Storm Petrel (*F. tropica*).

11.05 to 11.15 hrs. Two more Mascarene Black Petrels passed.

11.25 hrs. 3 more white-bellied storm petrels passed; they glide low over the swell, much more so than Wilson's; they often drop their feet and paddle; they do not join our wake.

11.30 hrs. Solitary Sooty Tern flying close to port; Indian Tropic-bird crossed, flying S. about 50 ft. above water; one Wedgetailed Shearwater and one Mascarene Black Petrel.

11.45 hrs. 2 more Whitebellied Storm Petrels close to our bows; 2 Wedgetailed Shearwaters rose off the water close to our bows; their longer beaks could be seen distinctly; several more crossed soon afterwards, all flying S.

11.50 hrs. to Noon. 2 more Wedgetailed Shearwaters and 2 more Whitebellied Storm Petrels; the latter seem generally to fly in pairs, but sometimes singly. One Mascarene Black Petrel crossed.

12 *Noon. Lat.* 10.24*N. Long.* 63.25*E. Distance run* 351 *miles; average speed* 14.95 *knots.*

Swell moderate, little choppy with low waves breaking; light breeze from SW.; bright and sunny; visibility excellent.

12.05 hrs. to 12.30 hrs. Small numbers of dark shearwater-like birds passing; majority appear to be Wedgetailed but two were certainly Mascarene Black Petrels. Another Whitebellied Storm Petrel at 12.30 hrs.

12.45 hrs. One Wedgetailed Shearwater and 2 Whitebellied Storm Petrels crossed.

14.50 hrs. to 16.15 hrs. One Wedgetailed Shearwater rose from water, flew round and settled again; several others crossed from time to time together with one Mascarene Black Petrel.

16.20 hrs. Party of 15 to 20 Sooty Terns, circling 100 ft. above water, passed slowly N., sun glistening upon their white underparts.

16.40 hrs. Single Whitebellied Storm Petrel passed. Sea has now moderated into a long, slow swell, slightly choppy with an occasional wave breaking; visibility excellent.

17.50 hrs. Wedgetailed Shearwater flying N.; another Whitebellied Storm Petrel passed.

18.05 hrs. Another Whitebellied Storm Petrel close in on port bow; line down centre of abdomen could be distinguished; no other birds seen before dusk.

August 8th. Indian Ocean.

06.00 hrs. to 11.20 hrs. Slight breeze from SE.; sea smooth with long swell and slight ripple; sunny; visibility excellent. No birds.

11.21 hrs. Solitary large, dark brown shearwater (*Puffinus* sp.) flying S.; possibly *P. carneipes*, the Pinkfooted Shearwater; it being too stout for *P. pacificus*. No other birds before noon.

12 *Noon. Lat.* 09.02*N. Long.* 69.13*E. Distance run* 355 *miles; average speed* 15.10 *knots.*

Noon to 16.00 hrs. Slight swell and ripple; fine but overcast. No birds.

16.10 hrs. Solitary dark shearwater passed far out.

16.20 hrs. to 18.00 hrs. No birds.

August 9th. Indian Ocean.

Approaching Ceylon—Passed Minicoy Antoll about 04.00 hrs.

06.20 hrs. Sea calm, with very slight swell and ripple; very light breeze from S.; fine but slightly overcast; visibility excellent.

06.30 hrs. Two Wilson's Petrels flying to and fro across our wake.

06.40 hrs. to 07.20 hrs. Several Wilson's Petrels passed; at 07.00 hours there were four quartering our wake and others passing.

08.15 hrs. 5 Wilson's Petrels in wake.

09.10 hrs. to 11.30 hrs. Wilson's Petrels in wake gradually increased in number until 25 to 30 were flying to and fro; others crossed our bows.

12 *Noon. Lat.* 07.45*N. Long.* 75.11*E. Distance run* 365 *miles; average speed* 15.52 *knots.*

Sea moderately calm, with slight, long swell and little ripple with occasional breaking waves; some cloud but generally sunny; visibility excellent.

12.15 hrs. 15 to 20 Wilson's Petrels in wake.

12.40 hrs. Single Wilson's Petrel in wake.

13.45 hrs. No petrels in wake; no birds of any sort to be seen.

15.40 hrs. Medium-sized, dark brown shearwater and one Wilson's Petrel to port; shearwater seems to be a Wedgetailed.

15.45 hrs. Petrels have reappeared; there are now 12 flying in our wake; all appear to be Wilson's.

16.40 hrs. Tropic-bird flew over; red beak; short, sharp tail with brown markings on upper parts; probably a juvenile. 12 to 20 Wilson's Petrels in wake.

17.05 hrs. Two shearwaters crossed flying S.; moderately large; dark brown, almost certainly Wedgetailed or Greenbilled (*P. pacificus chlororhynchus*) which is the common shearwater of these waters during the summer.

17.35 hrs. Another shearwater. Still 15 to 20 Wilson's Petrels in wake.

17.45 hrs. to 18.35 hrs. Several more Wilson's Petrels and dark brown shearwaters passed; at dusk there were still 4 or 5 Wilson's in wake.

20.30 hrs. 2 Wilson's Petrels (*Oceanites oceanicus*) were brought to me alive; both had hit the lights on the Sports deck and fallen down unharmed. Both typical Wilson's; they roosted quietly in a cupboard in my cabin and were released the following morning, after yielding some Mallophaga parasites. Both in fresh, unworn plumage.

August 10th. Indian Ocean. Arrived Colombo about 8 a.m.

05.45 hrs. Sea smooth, with slight swell and ripple; light breeze from S.; fine; visibility good. Several petrels can be distinguished flying to and fro in our wake. Colombo light is in sight.

06.15 hrs. to 06.40 hrs. Several Wilson's Petrels crossed, flying S. One Tropic-bird, in far distance astern; one shearwater crossed, undoubtedly a Greenbilled; 12 or more Wilson's Petrels in wake.

06.50 hrs. We are now approx. 4 miles from land; one Wilson's Petrel crossed our bows; those in wake gradually disappeared as we closed the harbour.

This voyage was chiefly notable for the very large number of Mascarene Black Petrels (*Pterodroma aterrima*) observed in the Gulf of Aden and in the vicinity of Socotra and the Whitebellied Storm Petrels seen on the 7th August. I had not definitely identified the Mascarene Black Petrel on previous voyages. On this voyage, the identity was confirmed by the one that came aboard on the evening of the 6th August. Persian and Wedgetailed Shearwaters were, as usual, seen in the vicinity of Socotra. It is curious that on the 7th August, when white-bellied storm petrels were numerous, not a single Wilson's Petrel was observed and that white-bellied storm petrels should have been seen only on that day. I have not previously seen this small petrel between Colombo and Aden, but I saw many that appeared to be of the same species near Lat. 18.20N. Long. 60.25E. between Aden and Karachi on a voyage in July 1945.

Undoubtedly there is room for considerable research into the oceanic birds of the northern Indian Ocean; not only is very little known of the species of migratory petrels and shearwaters that visit these waters during the summer months when they are not breeding, but it is obvious that several species must nest either on or in the vicinity of Socotra, as both Persian and Wedgetailed Shearwaters have been observed frequently in the vicinity of Socotra throughout the year.

On our return to Colombo, Mr. D. D. Condon was able to persuade Mr. G. N. Grisenthwaite, Fishery Expert in the Trawler '*Braconglen*' to keep notes on the oceanic birds encountered on his fishing trips. Although in no way a trained observer, Mr. Grisenthwaite is familiar with shearwaters and petrels which he has met in European waters; so he has been able to furnish some very interesting observations which throw light upon the density and distribution of migratory shearwaters and petrels in South India and Ceylon waters, and on the dates of their departure to the South.

The following are extracts from his reports, submitted through Mr. Condon:—

August 22nd. Left Colombo on north west course to Cape Comorin; picked up large flocks of Wilson's Petrels. Soon after leaving Colombo, there were scores of them. About 30 miles out on NW. course where sea's depth is very great, all petrels disappeared; there were no birds at all. 120 miles out on this course, off the South Indian coast, observed first shearwater and large numbers of Wilson's Petrels reappeared.

Note. Shearwater was probably the Greenbilled (*P. pacificus*) or Pinkfooted (*P. carneipes*), or both; he also saw many birds which, from his descriptions, were obviously Sooty and Bridled Terns (*S. fuscata* and *S. anaethetus*). He states that these terns never settle on the water, probably, he suggests, because of the large numbers of sharks always present! They come from the southwest in the morning and returned in the afternoon; they were not seen after 5 p.m. He assumes that they go to the Maldives or Laccadives to roost. On this voyage, Mr. Grisenthwaite also saw two tropic-birds and a dark brown 'gannet' (probably the Brown Booby, *Sula leucogaster*); it was taking flying-fish on the wing, when they left the water; he suggests that it was doing so, instead of diving for fish, as the sea was 'alive with sharks'!

September 9th to 15th 1953. Left Colombo 15.30 hrs. South-west monsoon blowing fairly fresh to strong; usual Wilson's Petrels in large numbers, gradually left behind after leaving continental shelf; this shelf of shallow water extends on a course direct for the South Indian coast, i.e. NNW.—exactly 14 miles from Colombo.

September 10th. Vessel engaged in deep sea trawling off Travancore coast, approx. 15 miles SE. of Cape Comorin. Many Bridled Terns observed not far from ship. Also Wilson's Petrels in flights of 2, 4, 6 and 8 but never more.

September 11th. West of Cape Comorin. Strong SW. wind; bird-life absent with exception of Wilson's Petrels, 21.30 hrs. Chief Officer reported Wilson's Petrel in his cabin; it had numerous parasites under the wing and amongst the breast plumage.

September 12th. West of Cape Comorin. One party of shearwaters or terns, evidently feeding, too far off for identification; another Wilson's Petrel came on board.

September 13th. Southwest of Cape Comorin; large numbers of shearwaters noticed with many Wilson's Petrels in company. Another Wilson's Petrel came aboard.

September 14th. Southwest of Cape Comorin. A few shearwaters noticed.

September 15th. Returned to Colombo.

September 18th to 23rd. SW. monsoon still blowing; course for Cape Comorin. A few miles out from Colombo passed several Wilson's Petrels but not so plentiful as during July, August and early September. Off Cape Comorin and Muttam for 5 days until 23rd September. Shearwaters, previously seen in this area, were gone; only on one occasion did I see 4 birds of the small sooty kind (*P. pacificus?*). Each and every day large flocks of Wilson's Petrels appeared—by this I mean hundreds. Our seamen, when gutting the fish, use old paint drums in which they put the offal. When they are full, they empty them overboard. This causes a distinct oil patch and it is marvellous to watch the little Wilson's Petrels flying in from every point of the compass until they are like a cloud over the oil patch. The shearwaters used to be seen feeding like this, but even cheap feeding is no attraction now; they have just gone.

September 30th to October 7th. Still SW. monsoon; no sea birds sighted between Colombo and Cape Comorin. Off West Muttam Light, and later 30 miles west of Cape Comorin, large flocks of Wilson's Petrels seen every day.

October 2nd. Caught one Wilson's Petrel after dark.

October 3rd. About 20.00 hrs., 16 Wilson's Petrels stranded on deck; four retained.[1]

October 7th. Leaving fishing grounds at 06.30 hrs. Still flocks of Wilson's Petrels to be seen but no shearwaters.

October 8th. Returned to Colombo.

Mr. Grisenthwaite is very emphatic that the Wilson's Petrels are seen only over the Continental Shelf area and never in the deeper water beyond this shelf.

October 13th to 23rd. Course as on previous voyages. Leaving Colombo in exceptionally fine weather only birds seen for 30 miles were occasional pairs of terns. No Wilson's Petrels were seen off Malabar Coast and Cape Comorin. Next day, however, Wilson's Petrels were seen in quite large numbers. With the exception of a few swallows (probably *Hirundo rustica gutturalis*) and other birds flying low over the water, obviously migrating towards the Gulf of Mannar, nothing further was seen. Returning to Colombo and whilst about 15 miles out, my old friend the Gannet (Brown Booby?)

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[1] See concluding note for identifications.

was sighted, a single bird only. I could not see its colour well as the day was just dawning, but the plumage appeared either dirty white or cream with a light beak. He appears to stay well off the land, because 12 miles from port he had left us.

October 31st to 9th November. Course as before. With the exception of an occasional tern, no birds were sighted; the Wilson's Petrels had all disappeared.

On Sunday November 8, however, I witnessed the spectacle of a huge flock of Wilson's Petrels, probably reaching for over a mile, crossing the bows of our ship, flying low down on the water and making a beeline almost SW. Mr. O'Connor, the second engineer, watched these birds with me. Mr. W. G. Mitchell, the skipper, says he has witnessed a similar flight before this and that the Wilson's Petrels will be back again during May next year.

Note by Mr. Condon. The Wilson's Petrels were seen about 140 miles NW. by W. of Colombo. Mr. Grisenthwaite said that there were thousands, flying mostly 20 or more abreast. As usual they were seen on the Continental Shelf. They appeared to be coming from the Indian Coast and, while he watched, there was no pause or hesitation, no feeding or resting, just this steady, fast mass-flight, moving South-west.

November 14th to 24th. Course approximately as on previous voyages. 'We were for the most of the time fishing off the Malabar Coast. The most interesting feature with regard to bird-life was the total absence of Wilson's Petrels. It is quite obvious that I witnessed the migration of these birds on Sunday November 8. I am, however, still puzzled as to where such a huge flock had congregated before their flight. From all appearances, it would seem that they came from the shallow water regions of the Gulf of Mannar as the flock was flying in a straight south-west direction and came from the coast to the north-east, which would be straight out from the Gulf. All the petrels have now completely gone.'

From Mr. Grisenthwaite's observations it is evident that the shearwaters (probably both *P. pacificus chlororhynchus* and/or *P. carneipes*) left Indo-Ceylon waters on or about the 20th September on their southward migration but Wilson's Petrels remained until the 8th November on which date a very large migration was observed. Regarding this migration, it is interesting to speculate from where the petrels had collected to form the very large concourse that was noted by Messrs. Grisenthwaite and O'Connor. Many of them were probably birds that had spent at least the latter months of their sojourn in our northern oceans, in the relatively shallow waters of the Continental Shelf of India and Ceylon, for these diaries show that there have been many Wilson's Petrels in Indo-Ceylon waters from at least early August to November 8th. Their numbers had probably been augmented, however, by other petrels from further north up the west coast of peninsular India, for there is believed to be a clockwise movement of Wilson's Petrels round the north Indian Ocean and moving south by way of the waters off Ceylon in September and November (Gibson-Hill 1948, p. 445).

On the other hand, as Mr. Grisenthwaite is very insistent that the birds all appeared to be flying on a south-westerly course out of the

Gulf of Mannar, it is possible that some, at any rate, came from the Bay of Bengal, passing down the east coast of India and through the Palk Straits and Gulf of Mannar between India and Ceylon. This course would be on the direct south-westerly route from the Bay of Bengal to the known breeding haunts of these petrels in Antarctica and the southern islands. Further observations on the movements of petrels and shearwaters in the Indian Ocean and Bay of Bengal are awaited with great interest.

SUMMARY

1. Extracts from the diaries of two voyages are given, showing the scarcity of petrels and shearwaters in the Indian Ocean and Gulf of Aden in early February and their abundance in early August.

2. The occurrence of phalaropes (*Phalaropus* sp.) in the Gulf of Aden in February is recorded and of the Mascarene Black Petrel (*Pterodroma aterrima*) in early August; also of a small white-bellied petrel, believed to be either the whitebellied Storm Petrel (*Fregetta grallaria*) or the Blackbellied Storm Petrel (*F. tropica*) in Lat. 10.24N. and Long. 63.25E.

3. Dates of departures in 1953 of shearwaters and Wilson's Petrels (*Oceanites oceanicus*) from Indo-Ceylon waters are given.

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ADDENDUM NOTE

Seven specimens of Wilson's Petrels, (*Oceanites oceanicus*), caught in the '*Braconglen*', were sent to the British Museum (Natural History) for determination of the races. Mr. J. D. Macdonald writing on 24th March, 1954, reports :—

> 'Your specimens are all in moult, but in four of them the new primaries appear to be full grown. These specimens are :—
>
> (1) 12-9-1953. 18 miles West of Cape Comorin, W.136. If fully grown, this bird could be *magellanicus*, and as a second alternative it could be *parvus*.
>
> (2) 11-9-1953. 29 miles South of Cape Comorin, W.140.5. As above.

(3) 12-9-1953. 25 miles South-west of Cape Comorin, W.145. Could be either *oceanicus* or *parvus* or even a very small individual of the Atlantic-breeding *exasperatus*.

(4) No. P.4 collected 3-10-1953. W.154. Almost certainly *O. o. exasperatus*.'

The above report would appear to indicate that Wilson's Petrels, from several separate breeding localities, congregate together in the northern Indian Ocean during the summer months or non-breeding season.

OBSERVATIONS ON *TILAPIA MOSSAMBICA* PETERS IN MADRAS

BY

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(*Freshwater Fisheries Biological Station, Madras*)

(*With six text figures*)

INTRODUCTION

The Cichlid fish, *Tilapia mossambica* Peters, is of economic importance as a source of protein for the population of Africa (Graham, 1929; Worthington, 1929; Wilbaux, 1946 & 1947; Hey, 1947; Bont, 1948; Sklower, 1951; Lowe, 1952). Owing to its great cultural value this fish has been introduced and cultured in several Asian countries such as Ceylon (De Zylva, 1952 & 1953), Indonesia (Hofstede and Ardiwinata, 1950; Hofstede and Botke, 1950; Vaas and Hofstede, 1952), Malaya (Burdon, 1950; Hickling, 1950) and Taiwan (Chen, 1953), from where favourable reports are made. The fish was first introduced into Madras from Ceylon on 8th September 1952, and the preliminary observations gave encouraging results (Devadas and Chacko, 1953 *a* & *b*). In this communication the salient features of further investigations carried out by us at the Freshwater Fisheries Biological Station, Madras, are recorded, in view of the many enquiries received from fisheries officers and fish farmers throughout India.

FOOD AND FEEDING HABITS

The fish has been found feeding mostly on the following algae:

Cyanophyceae: *Anabaena*, *Merismopedia*, *Microcystis*, *Oscillatoria* and *Tetrapedia*.

Chlorophyceae: *Actinastrum*, *Ankistrodesmus*, *Chlamydomonas*, *Chlorella*, *Closterium*, *Coelastrum*, *Cosmarium*, *Eudorina*, *Gonium*, *Mougeotia*, *Netrium*, *Pandorina*, *Pediastrum*, *Planktonema*, *Rhizoclonium*, *Scenedesmus*, *Selenastrum*, *Spirogyra* and *Staurastrum*.

Bacillariophyceae: *Amphora*, *Cyclotella*, *Fragilaria*, *Gomphonema*, *Gyrosigma*, *Navicula*, *Nitzschia*, *Pinnularia*, *Pleurosigma*, *Synedra* and *Tabellaria*.

Zooplanktonic organisms such as protozoans (*Euglena*, *Peridinum*, *Phacus* and *Volvox*), rotifers (*Anuraea* and *Brachionus*), daphnids (*Bosmina*, *Ceriodaphnia* and *Moina*), ostracods (*Cypridopsis*) and copepods (*Mesocyclops* and *Neodiaptomus*), and leaves of hydrophytes like *Hydrilla verticillata* and *Chara zeylanica* are also consumed in smaller proportions. Sand grains are frequent in the guts, indicating browsing at the bottom. Under aquarium conditions the fish is found to be omnivorous, feeding on plant matter, mosquito larvae, corixid bugs, shrimps (*Caridina nilotica*), cooked rice, rice bran, oil-cake, and strands of boiled meat. When starved, small carp fry introduced into the aquarium are consumed to a certain extent. *Barbus stigma, Brachydanio rerio*, *Gambusia affinis*, *Oryzias melastigma* and similar smaller species of fish when introduced into the aquarium are found to be attacked only rarely.

GROWTH

The fish attains a length of 220 mm. (9 inches) and a weight of 4 to 5 oz. in 8 months. The growth thereafter is slow, only 12 inches and 8 oz. being reached at the end of 16 months.

ASSOCIATION WITH OTHER FISHES

In the ponds of the Chetpat fish farm, Ippur fish farm, Yellamanchili demonstration farm and Chingleput fort moat farm, Tilapia is growing well in association with *Catla catla*, *Cirrhina mrigala*, *C. cirrhosa*, *C. reba*, *Labeo fimbriatus*, *L. rohita*, *Barbus sarana*, *Barbus carnaticus, Cyprinus carpio, Osphronemus goramy*, *Chanos chanos* and *Etroplus suratensis*. Carp fingerlings have been stocked with and without Tilapia in ponds of identical conditions; and observations on their growth did not show any difference.

MATURITY AND BREEDING

Tilapia attains maturity in Madras when about 90 to 100 mm. in size and 3 months old. The left ovary is slightly longer than the right one; and they contain 220 and 180 ova respectively. The mature egg is oblong and measures 20 to 22 mm. along its long axis. The mother has been noted to carry about 350 fertilised eggs in its mouth till the hatchlings attain a size of 9 to 10 mm. Breeders can be distinguished by the rosy tinge of their fins. Spawning is repeated at intervals of 8 to 10 weeks.

DEVELOPMENT

The fertilised egg measures about 25 mm. and has little pervitelline space. The yolk is yellowish-cream in colour and is minutely segmented. There are no oil globules. The eggs are reared successfully in aquaria for following embryonic development. By the end of the first day the eyes, auditory vesicle and few stellate chromatophores appear (fig. 1). At 36 hours after fertilisation the embryo is well

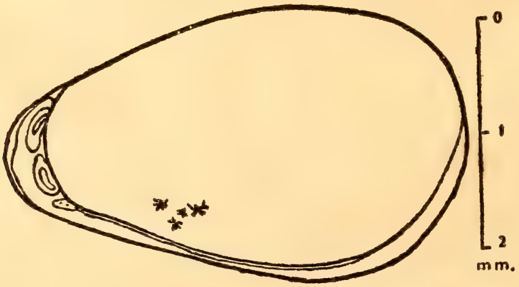

FIG. 1.—Embryo at end of first day of fertilisation.

defined with 11-14 myotomes. At the 48th hour, more chromatophores appear; and the embryo shows more myotomes, heart and blood vessels (fig. 2). On the third day the embryo almost completely encircles the yolk-mass, and shows wriggling movements within the membrane. At the end of the fourth day hatching commences. The hatchling is delicate and transparent, and measures 3.5 mm. in length and 0.35 mm. in width at the anal region. The yolk sac is 1.72 mm. in diameter. The eyes are not closed though pigmented bluish (fig. 4). On the second day after hatching the larva measures 5 mm. in length, and develops a yellowish tinge. Twenty-six myotomes are discernible. The eyes are fully developed but the mouth is not formed yet. The gills and pectoral fin buds appear. On the third day the larva is 5.5 mm. in length and shows occasional swimming

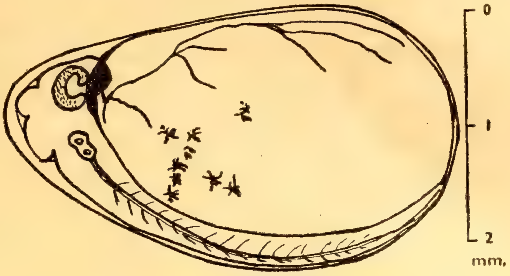

FIG. 2.—Embryo at the end of second day.

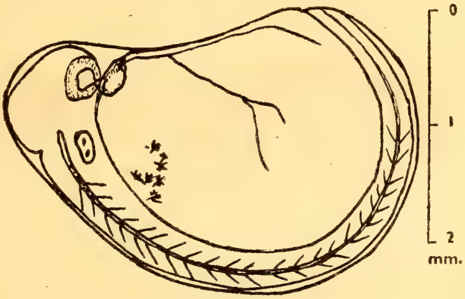

FIG. 3.—Embryo at the end of fourth day.

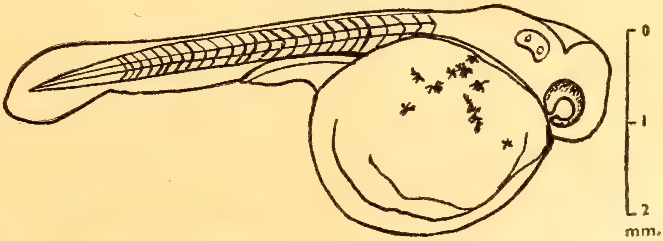

FIG. 4.—Hatchling.

movements at the bottom of the aquarium. Mouth is formed, and the caudal fin demarcated. Thirty myotomes are clearly seen. More chromatophores appear over the body, particularly on the head (fig. 5). On the fourth day the larva continues to remain at the bottom with occasional brief risings to the surface. On the fifth day, the yolk sac is almost absorbed, and the larva swims at the surface. The dorsal and anal fins are differentiated, and 7-8 rays can be counted in the former. Chromatophores get distributed thickly in the head, nape and pectoral region (fig. 6). On the sixth day, the larva commences to feed mainly on diatoms and on a few daphnids and copepods. On the seventh day, the larva is 7 mm. in length; and actively feeds on planktonic organisms. Twentyfive and twelve rays can be counted on the dorsal and anal fins, though the embryonic fin fold is still present. Pigmentation is spread almost all over the body. On the ninth day, the larva measures 8.5 mm., with its ventral portion yellowish-blue and the opercles golden in colour. The ventral fins are also formed. On the tenth day the chromatophores tend to crowd on the dorsal half of the body in the form of vertical bands. It is at this stage that the young ones are liberated by the mother from its mouth.

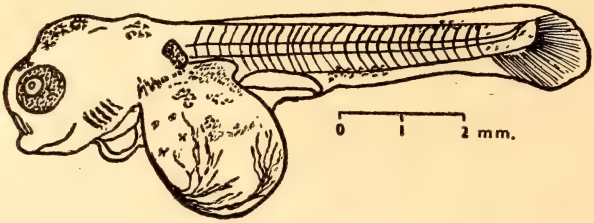

Fig. 5.—Three days old larva.

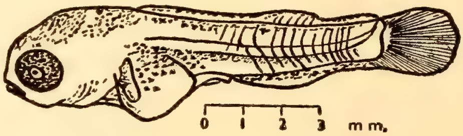

Fig. 6.—Six days old larva.

Suitability for culture in South India

Non-cannibalistic habit, rapid growth and propagation, parental care, harmless association with indigenous species, adaptability to different types of fresh and brackish waters, capacity to withstand handling and transport, and algicidal and mosquitocidal propensities make this exotic fish ideal for culture in South Indian waters many of which dry up in the summer. The seasonal waters can be stocked with Tilapia for raising a good fish crop within the short duration of water supply. It is also suited for the innumerable temple and village tanks, which are usually dirty and overgrown with algae. Its medium size and good flavour should make it popular with the rural population, especially as it can be purchased at a lesser cost than the large sized carps. It is also tasty and without small bones embedded in its flesh. It is neither possible nor practical to collect and transport all the required number of carp fry and fingerlings from the few rivers (the carp fisheries of which are not great) for stocking rural waters, which are not easily accessible for lack of means of communication. The majority of the estuaries and backwaters do not contain good fisheries excepting that of mullets. Introduction of Tilapia, a perennial breeder, into these waters will not only enrich their fisheries but also ameliorate the economic condition of the coastal fisherfolk, particularly during the season when there is no sea fishing. Thus Tilapia has great potentialities in South India and also in other parts of India.

ACKNOWLEDGMENTS

We are thankful to Sri K. N. Anantaraman, I.C.S., for according permission to publish this paper.

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ON THE STRUCTURE AND POPULATION OF THE NEST OF THE COMMON INDIAN TREE ANT, *CREMATOGASTER DOHRNI ROGENHOFERI* MAYR (HYMENOPTERA, FORMICIDAE)

BY

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(*With one table, one text-figure and three plates*)

Contents

PAGE
I. Introduction 354
(*a*) General 354
(*b*) Review of *Crematogaster* nests 355
II. Nest-structure and nest-population of *Crematogaster dohrni rogenhoferi* Mayr 357
(*a*) Nest-structure 357
(*b*) Nest-population 358
(*c*) Three nests from the Sundarbans, Lower Bengal 360
III. Other nests of *Crematogaster* sp. 361
IV. Summary 362
V. References 363
VI. Appendix 363

I. INTRODUCTION

(*a*) General

Although a description of the nest of the common Indian tree ant, *Crematogaster dohrni rogenhoferi* Mayr (Family Formicidae, Subfamily Myrmecinae, Tribe Crematogasterini) has been touched upon by several authors, e.g., Mayr (1878), Wroughton (1892 *a*, *b*) Rothney (1895), Watt (1898), Barlow (1900) and Lefroy (1909), they have merely described and figured the outer structure, and the few details available regarding the inner structure and the composition of the nest-material are either inadequate or faulty. No information is available regarding the nest-population. In the present account I have given a detailed and illustrated description of the outer and inner structure of the nest, the microscopic composition of its material and, finally, the composition of the nest-population. The account is largely based on a nest collected by me recently (17th May 1953). It was built 15 ft. above ground-level on the branches of a mango tree, *Magnifera indica* Linn., at New Forest, Dehra Dun (western Himalayas, *ca.* 2,000 ft. above sea-level). In addition, the following 5 nests are briefly described:— (i) Three small, young nests of *C. d. rogenhoferi* recently (January, 1954) collected by me from the forest on Kankramari *char* (island) in the Sundarbans, Lower Bengal. (ii) Two nests of *Crematogaster* sp. from South India.

(*b*) REVIEW OF *Crematogaster* NESTS

Information regarding the nests of the Indian species of the genus *Crematogaster* is both scanty and widely scattered. Here I have brought together and reviewed the available information.

It has long been known that ants of the genus *Crematogaster* construct large, globular or ovoid nests of papery material either high up on branches of trees or near ground-level. Sykes (1836, p. 101, pl. xiii, fig. 1) described and figured the nests of *Crematogaster physothorax* Emery[1], from the Maharashtra area in peninsular India, which are made among tree branches. According to him, 'they consisted of a multitude of thin folia of *cow-dung* imbricated like tiles upon a house, the folium above all covering the summit in an unbroken sheet, like a skull cap on a man's head'. In one case he also found a queen in the nest. According to Wheeler (1926, p. 215), Kirby (1837) also described the nest of *C. physothorax* Emery[1], and Mayr (1878) of *C. dohrni rogenhoferi* Mayr. Rothney (1895, pp. 205-206) mentioned having found a 'big brown-paper nest' of *C. dohrni rogenhoferi* Mayr at 'Bandora' near Bombay, but did not describe it. Wroughton (1892 *a*, p. 23) observed as follows: '*C. Rogenhoferi* and *C. ebeninus*, and perhaps some other species, (which) build nests of a material which looks like cow-dung, but which is, probably, a sort of coarse brown paper, manufactured from vegetable tissues, and suspend them from the branches of trees, like wasps' nests. The normal situation for the nest of a species is, however, not always strictly adhered to.' He further (1892 *b*, p. 197) remarked that *C.* [*dohrni*] *rogenhoferi* 'builds large nests of 'brown paper', with projecting pen-houses, more or less overlapping one another. The nests may usually thus be distinguished from those of *C. ebeninus*, which, at most, have only rudimentary verandahs. I believe this system of 'frills' is intended to give protection from the sun as much as from the rain; . . . '. Wroughton added that, according to the observations of Aitken, a woodpecker habitually rears its young in the nest of this ant. Barlow (1900, p. 185, pl. xv, fig. 1 *b*) gave a drawing of the nest of *C.* [*dohrni*] *rogenhoferi* Mayr. According to the same author, Watt (1898) made some observations on this species (wrongly identified by Watt as *Crematogaster contenta* Mayr) and found it as infesting tea bushes in Assam. Lefroy (1909, p. 228) gave a figure of the nest of the same species, as copied from Barlow (1900, *vide supra*).

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[1] Synonym : *Myrmica kirbii* Sykes 1836.

Hingston (1925) figured a nest of *C. auberti* from Baghdad, Iraq, which measured only about 4 cm. in diameter and was composed of seeds. Mukerji (1930, p. 153 and pl.) briefly described and figured a nest of *C. soror* Forel from Calcutta; according to him, the nest was composed of vegetable fibres, clay and debris. He added that Prof. Hans Molisch of Vienna, who had examined a piece from this nest, opined that it was composed chiefly of a fungus—a position which is very unsual in *Crematogaster*. Ayyar (1937) gave a detailed description of the nests of *C. dohrni artifex* Mayr from South India, and also briefly touched upon their chemical composition. The nests are globular or ellipsoidal and vary in size from a diameter of *ca.* 3 × 4 inches to about 9¼ × 11½ and 7 × 12 inches. He further remarked that the eggs and young larvae were found more towards the interior of the nest, and the pupae, the 'teneral adults' and the winged males more towards the periphery; the queens and the workers throng the interior of the entire nest. No special chambers are set apart for the queens. Beeson (1941, pp. 501-502) made a brief mention of the nest of *C. dohrni artifex* from the work of Ayyar (1937, *supra*).

To sum up, the papery nests of the genus *Crematogaster* in India and the neighbouring countries have been mentioned and briefly described by the following authorities, the only detailed description being that of Ayyar (1937) regarding the nest of *C. dohrni artifex* Mayr:—

C. auberti Emery.—BAGHDAD, IRAQ: Hingston, 1925.

C. dohrni artifex Mayr.—INDIA: Ayyar, 1937; Beeson, 1941.

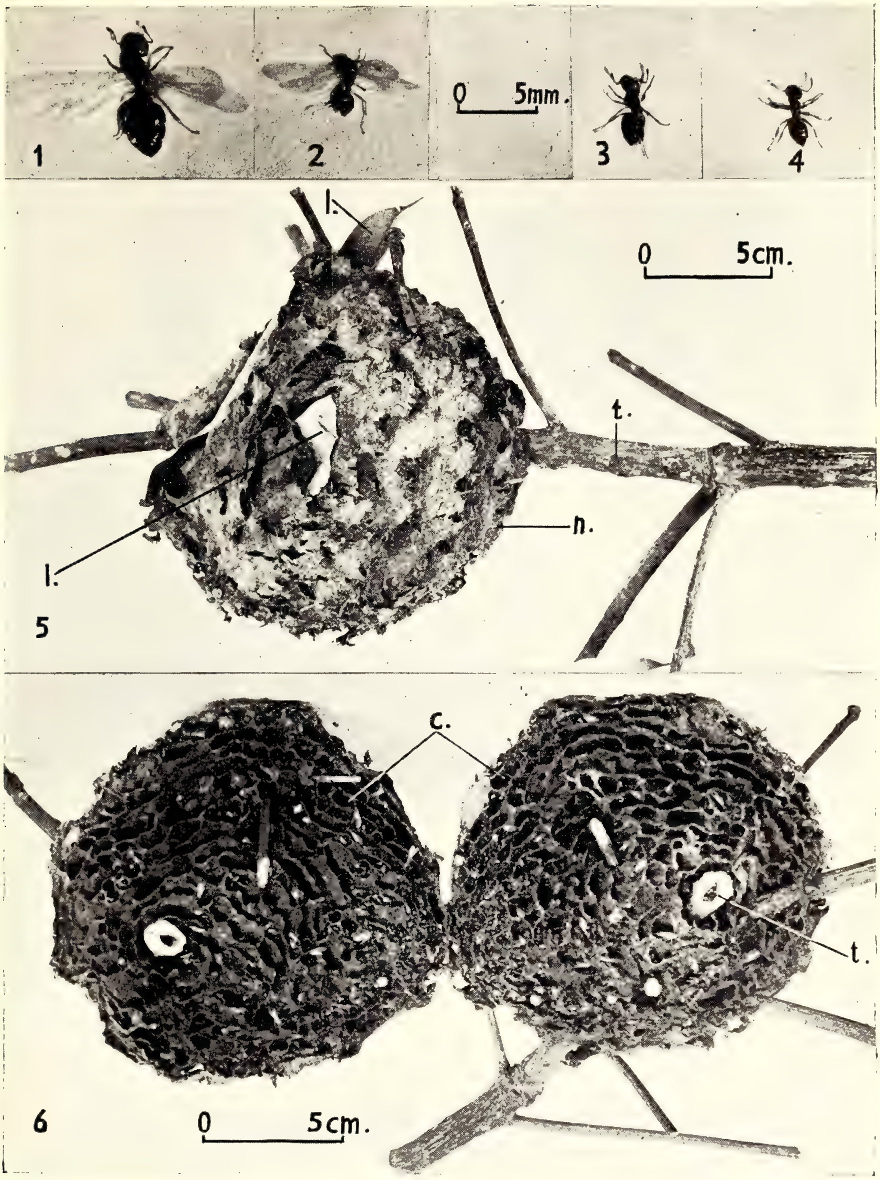
C. dohrni rogenhoferi Mayr.—INDIA: Mayr, 1878; Wroughton, 1892 *a*, *b*; Rothney, 1895; Watt, 1898; Barlow, 1900; Lefroy, 1909; Roonwal, present account.

C. physothorax Emery (synonym: *Myrmica kirbii* Skyes).—INDIA: Sykes, 1836; Kirby, 1837.

C. soror Forel.—INDIA: Mukerji, 1930.

Crematogaster sp.—INDIA: Roonwal, present account.

According to Ayyar (1937, pp. 296-297), *Crematogaster rothneyi* in South India does not build papery nests on trees but always nests in soil or in crevices in walls.



Photographs of *Crematogaster dohrni rogenhoferi* Mayr collected in New Forest, Dehra Dun (U.P., India) *ca.* 2,000 ft. above sea-level; 17th May 1953, M. L. Roonwal Coll. The individuals in figs. 1-4 are from the single nest shown in figs. 5 and 6.

1—Large winged form. 2—Small winged form. 3—Worker major. 4—Worker minor.

FIG. 5.—Whole nest as seen from outside. Built at a height of about 15 ft. above ground on a mango tree (*Mangifera indica* Linn.).

FIG. 6.—Same, cut into two halves to show the inside structure. The small white dots inside the cells represent the winged ants.

c—cells of the ant nest; *l*—dried up leaves of mango tree; *n*—nest; *t*—twigs.

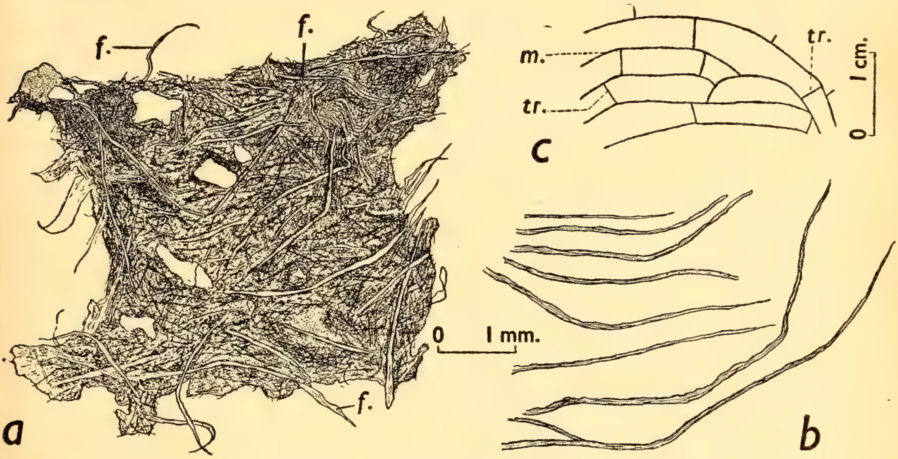
II. NEST-STRUCTURE AND NEST-POPULATION OF *Crematogaster dohrni rogenhoferi* Mayr

(*a*) NEST-STRUCTURE

(*Plate* 1 *and Text-figure*)

The Dehra Dun nest is a light, globular, dark brown structure, measuring about 13 cm. in diameter. It is composed of papery material giving the appearance of loose felt or dried cow-dung. Examination under the microscope shows that this material is composed of pieces of vegetable matter, e.g., grass leaves, bits of bark, etc., cemented together by some sticky secretion and moulded into light, papery stuff (text-fig. 1 *a*, *b*). The individual vegetable fibres are about 2-6 mm. long and are extremely thin. The nest weighs about 81 gms.

When the nest is carefully cut across[1] it is seen to be composed internally of a large number of interconnected cells which run more or less concentrically, the depth of the cells, i.e., the distance beween the neighbouring walls, being about 3-7 mm., and the width about 8-30 mm. or more. The cell-walls are about 0.5 mm. or less in thickness. The cells are strengthened by means of perpendicular or transverse walls (text-fig. *c*) of similar thickness and similar material. Towards the periphery of the nest the cells are narrower than in the centre. The nest is built around the tree branches in such



TEXT FIGURE (*a-c*)—Portion of a nest of *Crematogaster dohrni rogenhoferi* Mayr. (*a*) Portion of the outer covering of nest. Note that the nest is composed of vegetable fibres, bits of bark, etc. cemented together into a papery material. (*b*) A few of the longer vegetable fibres from the nest-wall. (*c*) A few nest-cells near the periphery of the nest.

f—vegetable fibres (bits of grass leaves, etc.); *m*—main cell-walls of nest; *tr*—transverse or perpendicular cell-walls of nest.

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[1] To avoid damage to the delicate, papery nest, the cutting is best done with a small, finely-toothed saw; a bread-knife is excellent for the purpose.

a way that several branches pass right across the nest. In the present case (pl. 1), besides the main twig which is about 1.5 cm. in diameter, 7 other thinner twigs pierce through the nest. Externally, the nest is covered over by a continuous covering of thin, papery laminae of the same material as the remainder of the nest and in such a manner that the nest-cells do not open on the outside except by tiny crevices here and there through which the ants enter and come out of the nest. These crevices are probably partly 'original structures', i.e. are laid down as such while the nest is being constructed and partly 'accidental', i.e., arise by the removal of the external covering here and there by mechanical injury caused by wind, contact with twigs and by other agencies.

(*b*) NEST-POPULATION

The nest-population in the Dehra Dun nest was counted by sampling. When the nest was kept aside after collection, very few individuals came out of it during the first few hours. The nest was then lightly dusted with 5 per cent D.D.T. powder and kept aside. Within an hour or two a large number of individuals—winged forms as well as workers—started crawling out of the nest and, by coming in contact with D.D.T., they died in the next few hours. In this way, individuals continued coming out for four days, after which there were no further emergences. All these individuals were collected. When the nest was cut into two halves after a week, a small number of dead individuals were still found in the nest cells, and were collected. The entire lot of individuals collected from the nest were stirred vigorously in spirit and a sample taken out with a small glass vial. These samples were transferred to another small glass vial of about 1 cm. height and 1.5 cm. inside diameter. The second vial was repeatedly tapped against a soft surface to make the ants settle down in a more or less tight uniform mass. When the tube was thus full to the brim, it was emptied in a glass dish and the contents counted and classified into castes, etc. The volume of the entire collection, in terms of the standard second tube, was then determined and the total number of individuals calculated. To this total a 5 per cent addition was made to account for the individuals still remaining in the nest. In this way the approximate grand total was obtained (Table).

The population consisted of 4 kinds of adults and the pupae, the former being characterised as follows:—

(i) Large winged adults—Body-length *ca.* 8 mm. Body golden brown; abdomen smoky.

(ii) Small winged adults—Body-length *ca.* 3.5 mm. Body golden brown; abdomen smoky.

(iii) Workers major—Body-length *ca.* 5.5 mm. Body golden brown; abdomen large and only faintly smoky, with a whitish band at the posterior margins of the terga.

(iv) Workers minor—Body-length *ca.* 4.5 mm. Body brown, darker than in worker major; abdomen small and darkly smoky (almost blackish to the naked eye), with no white bands at the posterior margins of the terga.

TABLE

Population of a nest of the tree ant, *Crematogaster dohrni rogenhoferi* Mayr, collected at New Forest, Dehra Dun, on 17th May 1953.

Stage and caste	Calculated total (from number actually counted)	Add 5 per cent for individuals left in nest	Total	Percentage of each caste among adults
1. Large winged adults ...	452	23	475	8 %
2. Small winged adults ...	110	6	116	2 %
3. Workers major	452	23	475	8 %
4. Workers minor... ...	4,676	234	4,910	82 %
Total (adults) ...	5,690	286	5,976	...
5. Pupae	14	3	17	...
GRAND TOTAL ...	5,704	289	5,993	...

The pupae were large and whitish and measured about 5-6 mm. in length.

The total calculated number of individuals (including the few pupae) in the nest, 13 cm. in diameter, was about 5,993 or say 6,000, the composition of the adult population being as follows:—

1. Large winged adults	... 475	individuals	(or 8% of total adults)
2. Small winged adults	.. 116	,,	(or 2% of total adults)
3. Workers major	... 475	,,	(or 8% of total adults)
4. Workers minor	... 4,910	,,	(or 82% of total adults)

Ayyar (1937, pp. 303-304 and 307-308) noted that in *Crematogaster dohrni artifex* Mayr in South India in swarming individuals the proportion of females never exceeded 3 per cent of the emerged sexual forms. He further gave the population of a nest, of about $5\frac{1}{2} \times 7\frac{1}{2}$ inches diameter, as follows:—

Caste, etc.	*Number and percentage of individuals*	
1. Workers major, including callows.	39,082 (68·6% of adults)	
2. Workers minor, including callows.	13,192 (23·2% of adults)	
3. Males, winged ...	4,614 (8·1% of adults)	8·2%
4. Females, winged ...	58 (0·1% of adults)	
(a) Total adults :	56,947	
5. Female pupae ...	816	
6. Female larvae, large size ...	634	
7. Smallest larvae, probably workers and males	2,744	
8. Pupae of workers and males ...	1,100	
(b) Total larvae and pupae	5,294	
9. Eggs	37	
(c) Grand Total	62,278	

The method adopted by Ayyar for counting the nest-population was by sample-weighments of lots. He, however, does not mention whether the samples were dried suitably or not before weighing. Unless uniform drying is done for all the samples, the degree of error in comparing the different samples is likely to be considerable. Assuming that Ayyar's figures provide a correct picture of the proportions of the various castes, a comparison with the proportions observed by me in *C. dohrni rogenhoferi* is of interest. The percentage of the winged adults is nearly the same in both the subspecies—10 per cent winged adults in *C. d. rogenhoferi* and 8.2 per cent in *C. d. artifex.* The percentage of the workers is also similar—90 per cent in *rogenhoferi* and 91.8 per cent in *artifex.* The relative proportion of the major and minor workers, however, differs radically and the tendencies in the two subspecies are, in fact, quite opposite, there being far more workers major (68.6 per cent of total adults) in *artifex* than in *rogenhoferi* (8 per cent of total adults). Correspondingly, the workers minor constitute only 23.2 per cent of total adults in *artifex*, as against 82 per cent in *rogenhoferi.* Among the workers themselves, the proportion of workers major to workers minor in *artifex* is 74.8 per cent and 25.2 per cent respectively or roughly as 3:1; in *rogenhoferi*, 8.1 per cent and 91.9 per cent respectively or roughly as 1:11. Another point of comparison is the density of population in the two nests. In the globular nest of *C. d. rogenhoferi*, with the nest-diameter of 13 cm. (the nest-volume, therefore, being *ca.* 1,151 cu. cm.) the population, including the 17 pupae, was 5,993 individuals, or about 5.2 individuals per cubic centimetre. In the oval nest of *C. d. artifex*, with the nest-diameters of $5\frac{1}{2} \times 7\frac{1}{2}$ inches or about 14 × 19 cm. (mean 10.5 cm.), the nest-volume worked out at about 2,630 cu. cm.; with a total population of 62,278, including larvae and pupae but excluding the 37 eggs, this gave a density of about 26.4 individuals per cubic centimetre, or nearly 5 times as great as in *rogenhoferi.*

(c) THREE NESTS FROM THE SUNDARBANS, LOWER BENGAL

(Plate II)

During a recent survey (January 1954) of the Sundarbans in Lower Bengal, I found small, young live nests of *C. d. rogenhoferi* common on the island named Kankramari *char*[1] which lies in the Muriganga River about 3 miles from Namkhana town. The ecological conditions obtaining on this island are of interest and may be briefly touched upon. The island, which is formed by silting, is of comparatively recent origin (about 60 years or so old) and is growing fast. It is about 8 miles long and about a quarter mile wide. The soil consists of clayey loam over stiff black clay and there is no rock. The altitude is about 15 ft. below the mean sea-level and the island is, therefore,

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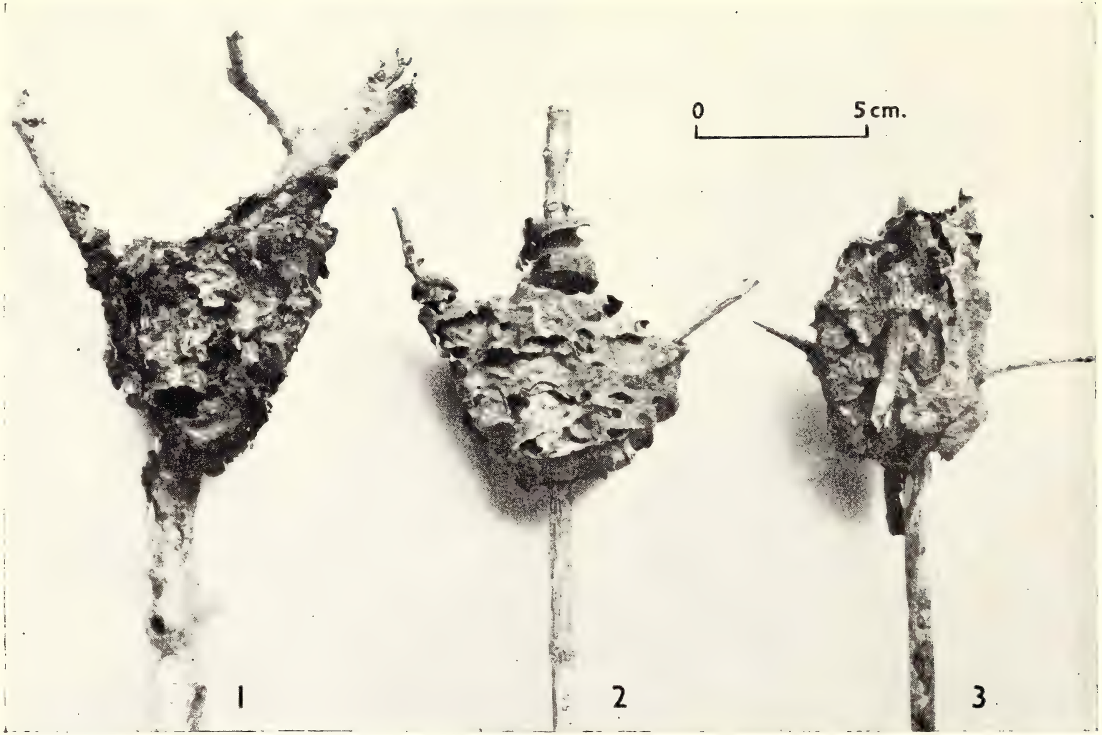
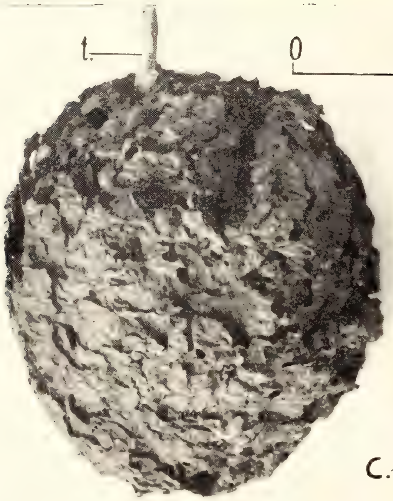
[1] *Char*, in the local dialect, means an island formed by silting.



Photographs of young nest of *Crematogaster dohrni rogenhoferi* Mayr, from the Kankramari *char* (Island), Muriganga R., the Sunderbans, Lower Bengal. M. L. Roonwal Coll., 2nd January, 1954.
1—Field Coll. No. R4/2-1-1954. 2—Field Coll. No. R5/2-1-1954. 3—Field Coll. No. R6/2-1-1954.



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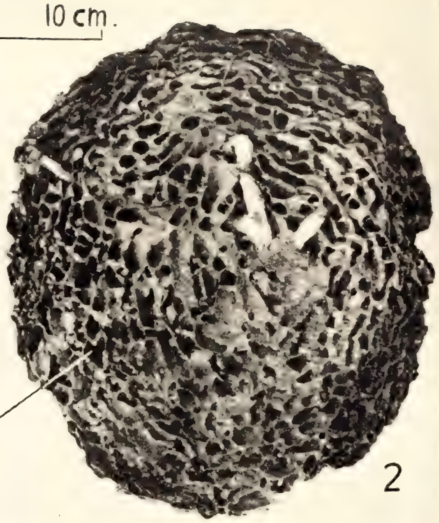

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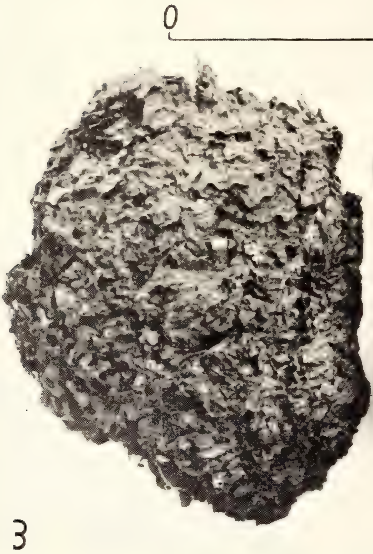

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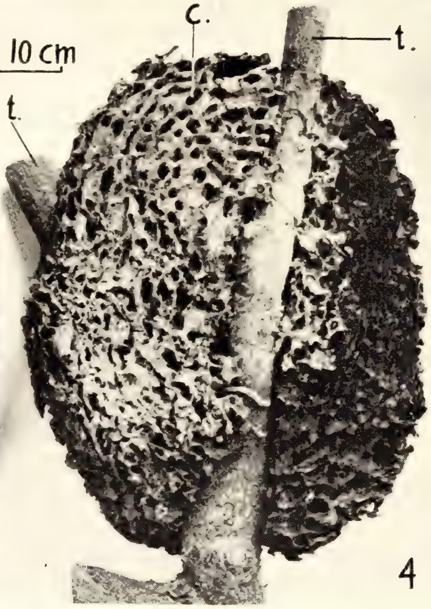

4

Photographs of nest of *Crematogaster* sp.

FIG. 1—Nest No. 1 (Ent. Mus. Reg. No. 1001A), as seen from outside. *Crematogaster* sp. North Salem Forest Division, Madras State, India. February 1930, C. F. C. Beeson Coll. Natural size: 17×20 cm. diameter.

FIG. 2—Nest No. 1 (Ent. Mus. Reg. No. 1001A), as seen in longitudinal-vertical section.

FIG. 3—Nest No. 2 (Ent. Mus. Reg. No. 1001B), as seen from outside. *Crematogaster* sp. Same collection data as in nest No. 1 above. Natural size: 13×17 cm. diameter.

FIG. 4—Nest No. 2 (Ent. Mus. Reg. No. 1001B), as seen in longitudinal-vertical section.

fully submerged under the saline estuarine waters during the spring tides (March to August) for about 3 hours in the day and 3 hours in the night. The ground is always marshy. The island is covered by a forest of the *Heritiera*-type, the principal species being *baen* (*Avicennia officinalis* L. and other species of *Avicennia*) and *gengwā* (*Exacaecaria agallocha* L.). *Goran* (*Ceriops roxburghiana* L.) has also come underneath *gengwā*; and occasionally *koreā* (*Sonneratia apetala* Ham.) is found. The forest crop is young and flourishing, the tree canopy about 20-30 ft. high and half open, and the girth of trees about 6-24 inches at breast height (4½ ft.). The larger mammals, e.g. tiger, wild boar and cheetal deer, have already invaded the island from the mainland. The insect fauna is poor: there are a few species of ants and grasshoppers; no termites were seen. It is obvious that only those ants which can nest high up in trees can survive because of the periodical submergence of the island under water.

Several nests of *C. d. rogenhoferi* were commonly seen on trees at heights of about 4-10 ft. from the ground. All of them were small in size and were evidently young. In shape they were rounded or subovoid with irregular protuberances. Three nests were collected on 2nd January 1954 and are briefly described below (pl. 2):—

Nest No. 1. (Coll. No. R4/2-1-1954) (pl. 2, fig. 1)—Subtriangular, the three sides measuring 7×7×9 cm.; height *ca.* 4 cm. Dark brown. Outer papery covering poorly developed. In a forked twig at a height of *ca.* 8 ft. on a *gengwā* tree.

Nest No. 2. (Coll. No. R5/2-1-1954) (pl. 2, fig. 2).—Subglobular but rather flattened, with diameters *ca.* 5 cm. and 7 cm., and with two projections for holding on to thin twigs. Dark brown. Outer papery covering rather more complete than in No. 1. Attached to thin forked twigs, at a height of *ca.* 8 ft. on a *goran* tree.

Nest No. 3. (Coll. No. R6/2-1-1954) (pl. 2 fig. 3).—Suboval, *ca.* 5×8 cm. Dark brown. Outer papery covering as in No. 2. Attached to thin, forked twigs at a height of *ca.* 4 ft. on a *goran* tree.

Except in size and shape, the external and internal structure of these nests was essentially the same as in the Dehra Dun nest described above. The population consisted solely of major and minor workers.

III. OTHER NESTS OF *Crematogaster* SP.

(Plate III)

Besides the nests of *C. dohrni rogenhoferi* described above, there are two other nests of *Crematogaster* sp., both from South India, in the collection of the Forest Entomologist, Forest Research Institute, Dehra Dun. While these nests clearly belong to *Crematogaster* sp., no ants are now present in them and it is, consequently, not possible to determine the species. The nests largely resemble those of *C. dohrni rogenhoferi* described above, but show certain differences and are briefly described below:—

Nest No. 1. (pl. 3, figs. 1 and 2)—Ent. Mus. Reg. No. 1001A. The only data recorded are as follows: *Crematogaster* sp. Formicid nest made up of leaves on the branches of some tree. North Salem [Forest] Division, Madras [State]. February 1930. Dr. C. F. C. Beeson.

The nest is dark brown (cow-dung coloured) and ovoid in shape, the diameter being about 17 × 20 cm. It is made up of numerous cells generally shaped as described above for *C. d. rogenhoferi* and composed of papery material which, under a lens, is seen to be composed of numerous small vegetable fibres cemented together—it is *not* 'made up of leaves', as stated in the original label. The cells appear to be proportionately smaller in width than in the nest of *C. d. rogenhoferi* but are otherwise similar to the latter. The nest weighs about 245 gms.

Nest No 2. (plate 3, figs. 3 and 4)—Ent. Mus. Reg. No. 1001B. Same collection data as in No. 1001A above. The nest is oval and measures about 13 × 17 cm. in diameter but is otherwise markedly different. It is much darker brown, being almost blackish. The cells are appreciably smaller than in the nests described above, and also much more irregular. In a transverse section the peripheral portions, especially on one side, are much darker, while the central portions appear to be paler owing to a fine, white, powdery deposit on the cell-walls. The central cells are larger than the peripheral ones. The nest weighs about 152 gms.

IV. SUMMARY

1. The published information on nests of the Indian species of tree ants of the genus *Crematogaster* is briefly reviewed.

2. The nest of *Crematogaster dohrni rogenhoferi* Mayr is globular, is constructed high up on trees, and is made of dark brown, papery material composed of fine vegetable fibres glued together by means of a secretion. The inside of the nest is composed of numerous interconnected cells. Externally the cells are covered over by a continuous layer of papery laminae, so that the peripheral cells do not open on the outside except for small chinks here and there. The Dehra Dun nest measured about 13 cm. in diameter and weighed about 81 gms.

3. The ant-population, in a nest about 13 cm. in diameter and collected at New Forest, Dehra Dun, on 17th May 1953, consisted of about 5,993 (or say 6,000) individuals, comprising 5,976 adults and 17 pupae. The proportion of the four kinds of adults was as follows:—(i) Large winged adults, 475 (8%); (ii) small winged adults, 116 (2%); (iii) workers major, 475 (8%), and (iv) workers minor, 4,910 (82%).

4. The density of population was about 5.2 individuals per cu. cm.

5. A detailed comparison of the population-structure in *C. d. rogenhoferi* with that of *C. d. artifex* Mayr (as studied by Ayyar, 1937) is made. This reveals certain similarities as well as some striking contrasts.

6. Some small nests of *C. d. rogenhoferi* from the Sunderbans, Lower Bengal, are described.

7. Two other nests of *Crematogaster* sp., from South India, are briefly described.

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VI. APPENDIX

I have now been able to consult Watt (1898) and Watt & Mann (1903) in original. These authors clearly state that *C. dohrni* is a pest of tea bushes in Assam and Ceylon, injuring the bark and branches to such an extent that circulation is checked and death occurs. They add that the belief that the ants are useful by keeping in check the harmful aphids and coccids is incorrect, and, on the contrary, they protect these insects. In Ceylon, according to the same authors, this ant injures cinchona, coffee and tea. Watt's (1898, p. 257; 333) statement that the ant makes 'mud enclosures' (or nests) is of course not correct as discussed above, the nest being composed entirely of fibrous laminae. Watt & Mann (1903, pl. XIII) figure a globular nest of *C. dohrni rogenhoferi*.

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NOTES ON THE BUTTERFLIES OF THE NAGALAPURAM HILLS, EASTERN GHATS

BY

A. E. G. BEST

During the two years from April 1950 until the end of February 1952, I paid frequent visits to the Nagalapuram Hills which form the outer spur of the Eastern Ghats between Nagari and Kalahasti. These hills extend for about 30 miles from south to north, the southernmost end being about 40 miles NW. of Madras City.

These hills are, as far as I know completely uninhabited and are covered with thick jungle, the southern end being bare rocky peaks. There are no signs of grazing goats or cattle but there are numerous tracks of sambar and barking deer on the forest paths; judging from the droppings and pug marks there must be a number of sloth bears and panthers and on one occasion I saw a couple in the early morning. The Grey Junglefowl is fairly common and I have also seen an occasional spurfowl.

The highest point is Kumbakkam Drug (about 2,700 ft.) and just below this is an unattended Forest Bungalow. But it is a long hard walk of 5 miles from the Government Fish Farm at Thantipandal and without careful arrangements made well before hand it is impossible to obtain coolies to carry one's baggage to the top of the hill.

There is no fresh running water on the plateau except in the monsoon, but there are two small pools—one about one mile to the north of the bungalow and another 1½ miles to the west. The first 2 miles from Thantipandal the ascent is very steep to about 1,900 ft., thereafter the path is along a rolling plateau gradually ascending to 2,500 ft.

Around the northern edge of the hills is a small clear stream with a permanent flow of water which appears to emanate from a spring halfway up the hill. The jungle round the bottom of the hills is thick scrub with some big mango and other trees and some patches of bamboo jungle. This stream flows into a small artificial tank.

Most of my collecting was done on the northern end of the hills as the southern and central parts are not easily accessible, at any rate for short visits.

The rainy season is from mid-October to the end of November, but there are frequent heavy showers from July to September.

There is one point which seems to me of particular interest and this is the scarcity of females of *Papilio polytes* compared to the very large number of males. In the two years spent among these hills, I certainly did not see more than 12 females, all of form *stichius*. This in itself seems peculiar as *P. aristolochiae* which *stichius* mimics is comparatively scare while *P. hector*, which the typical form mimics, is the commonest *Papilio* and hundreds and even thousands are seen every day. It is possible that I may have missed form *polytes* and passed them as *hector*, but I can usually distinguish between the two in flight and was always on the lookout for them.

PAPILIONIDAE

1. **Polydorus aristolochiae aristolochiae.**

Rather scarce, but usually three or four to be seen every day.

2. **Polydorus hector.**

Very common at all seasons, round the lower slopes of the hills, but scarce at the top. This is one of the commonest species and is often seen in swarms of hundreds.

3. **Papilio polytes polytes.**

Males fairly common from August to November but scarce at other times. On the 9th September 1950 after a week of heavy showers males of this butterfly appeared literally in thousands on wet ashes. There had been a forest fire along the banks of the stream and these patches of ashes were covered with hundreds of butterflies, the commonest being *P. polytes*, *P. demoleus*, *G. nomius*, *G. eurypylus jason, C. pomona, C. nerissa, A. libythea.* Among the *P. polytes* was a male which had distinct light blue scaling on lower h.w. between the discal series of white spots and the discal edge of the wings in interspaces 1-7. The underside of the h.w. had a series of small blue lunules under the discal series of white spots. This butterfly was quite conspicuous among a crowd of about 40 *P. polytes* hovering and settled over wet ash. Now after 18 months the set specimen still shows the unusual markings though they have faded somewhat.

Females of all forms are scarce and during the whole two years not more than 12 of form *stichius* were seen and none of the other forms.

4. **Papilio polymnestor.**

Only one was seen in July flying down the river, but the wings of another were seen floating in a pool at the end of June.

5. **Papilio crino.**

Scarce at most times of the year but saw one in November and took another early in December on thistle. The next time this butterfly was seen was at the top of the hill in April when 9 were seen round the summit of Kumbakkam Hill. No others seen except at the top of the hill in August.

6. **Papilio demoleus demoleus.**

Very common everywhere and at all times of the year.

7. **Chilasa clytia clytia.**

Scarce—only one tattered specimen seen at the bottom of the hill, but always one or two to be found round the summit. These vary in colour from almost black to a rusty brown.

8. **Chilasa clytia dissimilis.**

Scarcer than *clytia clytia,* and only seen round the summit of Kumbakkam.

9. Graphium agamemnon menides.

Scarce at all times—a few seen in August near the top of the hill and others on lantana.

10. Graphium teredon sarpedon.

Very scarce—a few taken on damp rock near a spring on the top of the hill in October.

11. Graphium eurypylus f. jason.

Very common at the bottom of the hill along the stream, especially from August to January. They come to damp patches in numbers and are easy to catch when settled but are very rapid fliers.

12. Graphium nomius nomius.

Fairly common in July only but these have been seen throughout the year. On the 25th July there were hundreds newly hatched, whereas on the 9th August only one was seen and again in early September only one was seen.

PIERIDAE

1. Leptosia nina nina.

Not common, but a few seen in wooded areas on the lower slopes of the hill.

2. Delias eucharis.

Rather scarce but usually a few to be seen most days.

3. Appias libythea libythea.

Males common at most times of the year, but females scarce.

4. Appias albina.

Scarce, but a few males taken on wet patches of sand.

5. Catopsilia crocale.

Males fairly common, but females very scarce—only two seen over the entire period.

6. Catopsilia pomona.

Very common.

7. Catopsilia pomona f. catilla.

Only one seen and taken.

8. Catopsilia pyranthe.

Common.

9. Eurema libythea.

Scarce.

10. **Eurema hecabe simulata.**

Scarce.

11. **Cepora nerissa phrynne.**

Very common.

12. **Ixias pyrene frequens.**

Rather scarce, but usually a few to be seen at the bottom of the hill and along the stream.

13. **Ixias marianne.**

As above.

14. **Anapheis mesentina.**

Usually very scarce except on one day in September when there were hundreds about and many pairs were seen *in copula.*

15. **Colotis amata amata.**

Scarce, but always one or two to be seen on most days.

16. **Colotis etrida.**

Fairly common in the scrub jungle at the foot of the hill.

17. **Colotis danae.**

Common in scrub jungle at the foot of the hills.

18. **Colotis faustia fulvia.**

Fairly common in same places as *etrida* and *danae.*

19. **Colotis modesta modesta.**

A few seen as above.

20. **Valeria valeria hippia.**

Very scarce indeed and only three seen in the entire period, all males.

21. **Valeria ceylonica.**

One only seen and taken.

DANAIDAE

1. **Danais limniace mutina.**

Common at all seasons.

2. **Danais plexippus.**

Very common.

3. **Danais chrysippus.**

Very scarce—only a dozen or so seen during the entire period.

4. **Euploea core core.**
Very common.

5. **Euploea coreta coreta.**
Very common.

Note.—These two *Euploeas* are both about equally distributed.

SATYRIDAE

1. **Mycalesis perseus.**
Very scarce.

2. **Lethe rohria nilgiriensis.**
Only one seen at the top of the hill round damp rocky outcrops.

3. **Ypthima hubneri.**
Common round the foot of the hill.

4. **Melanitis leda ismene.**
Very scarce.

ERYCINIDAE

1. **Abisara echerius prunosa.**
Very scarce.

2. **Libythea myrhha myrhha.**
Very scarce—only three seen.

NYMPHALIDAE

1. **Charaxes polyxima imna.**
Fairly common round the peak of the hill at midday. One male was seen on fresh bear droppings. No females seen at any time.

2. **Charaxes fabius fabius.**
A few seen at the peak and others at the bottom of the hill on rocks by the stream.

3. **Eriboea athamas.**
Common at the peak and in several places on the rocks in the middle of the stream.

4. **Euthalia nais.**
Fairly common all over the area.

5. **Limenitis procris procris.**
Scarce. A few seen at higher elevations.

6. **Neptis columella.**
Common at higher elevations.

7. **Neptis hylas varmona.**

Common throughout the area.

8. **Rahinda hordonia.**

Scarce, but usually one or two at the foot of the hills.

9. **Precis hierta hierta.**

Fairly common.

10. **Precis lemonias vaisya.**

Common.

11. **Precis iphita pluvialis.**

Common.

12. **Precis almana almana.**

Very scarce—only two seen near the stream.

13. **Precis orithiya.**

Common everywhere.

14. **Vanessa cardui.**

Only two seen.

15. **Hypolimnas bolina.**

Very scarce—no males seen.

16. **Hypolimnas missipus.**

Males very scarce—all but one seen being in the jungle at the bottom of the hill and near the stream. No females were seen in this locality but they were quite plentiful near the hill-top where only one tattered male was seen.

17. **Atella phalanta.**

Very common.

18. **Ergolis merione taprobana**

Very common.

19. **Ergolis ariadne.**

Common.

20. **Telchinia violae.**

Very common everywhere.

21. **Biblia ilythea.**

Rare, but there were several on the banks of a small tank into which the stream empties about 2 miles from the foot of the hills.

LYCAENIDAE

1. **Castalius rosimon rosimon.**
Not rare, usually one or two to be seen at low levels.

2. **Castalius deleta decidea.**
Very scarce—only three taken in two years.

3. **Spalgis epius.**
Scarce—a few near the stream.

4. **Talicada nyseus.**
A single one taken near the summit of Kumbakkam in September. No others seen.

5. **Syntarucus plinius.**
Scarce—two near the stream and others on the main road in July and August.

6. **Lycaenopsis puspa gisca.**
Fairly common at low level.

7. **Chilades laius laius.**
Very common at low levels, July to October. Sometimes swarms at damp patches on the forest road.

8. **Zizeeria trochilus putli.**
Common.

9. **Zizeeria lysimon.**
Common.

10. **Zizeeria otis decreta.**
Scarce.

11. **Euchrysops cnejus.**
One only on the plateau at 12,000 ft., October.

12. **Lycaenesthes lycaenina lycaenina.**
Two at hill-top near a small spring of water.

13. **Catachrysops strabo.**
Common.

14. **Lampides boeticus.**
Scarce—only one taken near hill-top, but others seen.

15. **Jamides celeno celeno.**
Scarce—females particularly so. All seemed to be of very pale colour.

16. **Curetis thetis.**

Males fairly common—only two females seen.

17. **Horsfieldia anita dina.**

Fairly common on the banks of the stream, July to September. Not seen elsewhere.

18. **Amblypodia amantes amantes.**

Common, particularly on the plateau. Males sometimes came to damp sand.

19. **Surendra quercetorum biplagiata.**

Fairly common.

20. **Loxura atymnus atymnus.**

Very scarce—only two, both in October.

21. **Apharitis lilacinus.**

Only one taken in February near Kumbakkam peak.

22. **Spindasis vulcanus vulcanus.**

Fairly common in April on the plateau. Also seen in September and October.

23. **Spindasis ictis ictis.**

Two poor specimens taken in April—no others seen.

24. **Tajuria cippus cippus.**

Several on the top of the hill in August. Two taken in the valley in November. No others seen.

25. **Rathinda amor.**

Common August to October, but very small compared to Bombay specimens.

26. **Rapala melampus.**

Two males seen and one taken in December in valley.

Note.—I have three more lycaenids which I have been unable to identify so far.

HESPERIIDAE

1. **Hasora alexis alexis.**

Only one taken but several seen in October, November and December.

2. **Badamia exclamationis.**

Fairly common.

3. **Calaenorrhinus ambareesa.**

Three only, all in October.

4. **Calaenorrhinus leucocera leucocera.**

Two only in November.

5. **Tagiades litigiosa litigiosa.**
Only one in October.

6. **Coladenia dan dan.**
Common.

7. **Coladenia indrana indra.**
Fairly common.

8. **Tapena thwaitesi hampsoni.**
Only one taken in November, and another seen the same day.

9. **Caprona ransonetti ransonetti.**
Common.

10. **Caprona agama pelias.**
Only one taken in July.

11. **Syrichtus galba.**
Fairly common.

12. **Ampittia diascorides.**
Scarce.

13. **Aeromachus dubius.**
Two taken in October.

14. **Suastus gremius gremius.**
Three taken in October.

15. **Udaspes folus.**
Only one taken in October.

16. **Notocrypta paralysos alysia.**
Common.

17. **Gangara thyrsis thyrsis.**
Seen twice October, but missed each time.

18. **Taractocera ceramus ceramus.**
Common.

19. **Astycus pythias lanka.**
Only two taken in March and May.

20. **Baoris kumara kumara.**
Only one in April.

21. **Baoris zelleri cinnara.**
Fairly common.

Note.—There are two more specimens which I cannot identify with certainty.

THE BIRDS OF GUJARAT

BY

SÁLIM ALI

PART I

(With a map and five plates)

INTRODUCTION

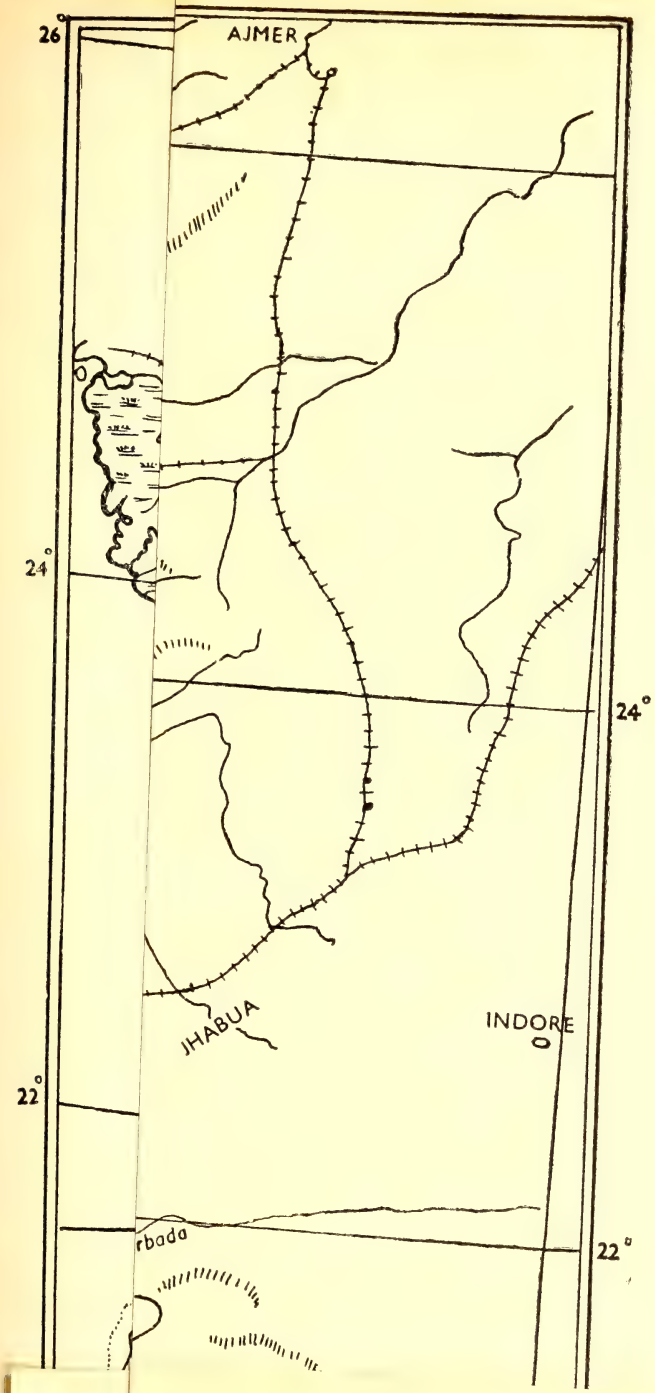
The publication of this paper has been unduly delayed. The main field work of which it is the outcome was undertaken for varying periods of a month to five months at a time between the years 1944 and 1946 with shorter field trips up to 1948. It covered the then State territories of Kutch, Baroda (including its Kathiawar enclaves), Rajpipla, Cambay, Palanpur, and Radhanpur, together with the cluster of tiny Bhil States known as the Surat Dangs. Financial and other assistance was generously provided by the darbars concerned, and supplemented by a welcome grant from the Gujarat Research Society.

Publication even at this late date is considered desirable in view of the great deal of fresh distributional and ecological data brought to light by the field surveys and the study material collected, which seem worthy of being put on permanent record. I have tried to make the paper as comprehensive as possible by collating other available information, either previously published or since supplied by competent observers. For various reasons I was unable to cover the Kathiawar peninsula except only fragmentarily, but happily this gap in our knowledge will be filled by K. S. Dharmakumarsinhji's shortly forthcoming book on the Birds of Saurashtra. The author being a keen and knowledgeable resident ornithologist of Bhavnagar will doubtless furnish fuller information than a short seasonal survey or two would have made possible.

My thanks are due to the Bombay Natural History Society for lending me, as usual, the services of their collectors and skinners Messrs. J. Gabriel and L. Nogueira, whose assistance was invaluable and greatly appreciated.

The draft of the major portion of this report was prepared many years ago, at the time the collections were first worked out; therefore some of my notes, such as on the status of various species (written in the present tense) may already be much out of date. Conditions affecting wildlife in general, directly or indirectly, have changed and are changing rapidly, and unhappily not for the better. This is particularly noticeable in the case of areas whose erstwhile rulers were actively interested in the preservation of wildlife in their respective territories.

In view of the recent changes in the political structure of the country, it seems necessary to define the entity 'Gujarat' as used in the title above. It is all that tract of country in Bombay State, some 64,000 sq. miles in area, which stretches down the western side of India from Sind in Western Pakistan (*ca.* 24°30′N) to the southern boundary of Surat District (*ca.* 20°15′N). In addition to the former Indian administrative districts of Ahmedabad, Kaira, Panchmahals, Broach and Surat, it includes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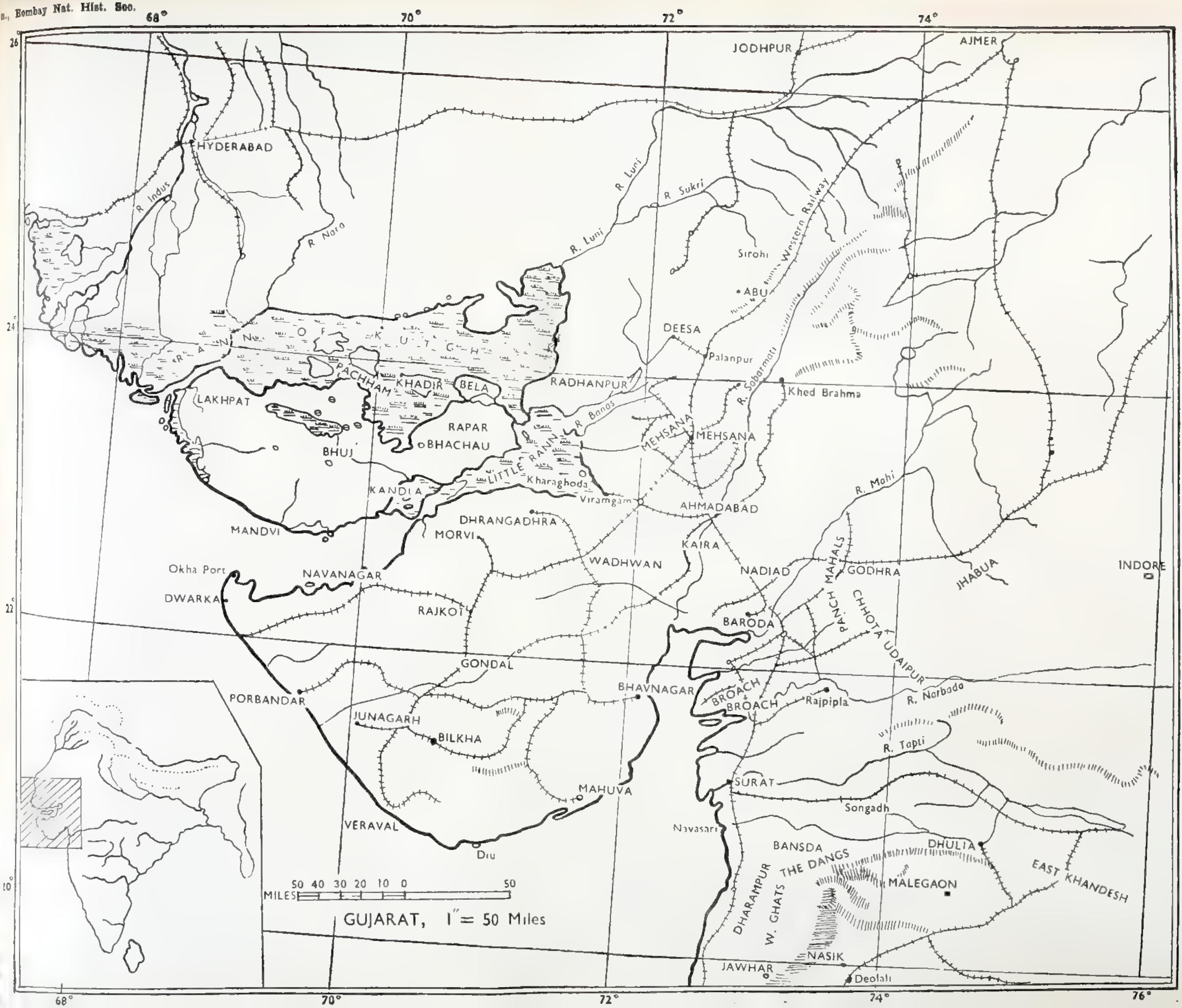
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R. Luni
R. Sukri
Sirohi
Western Railway
ABU
DEESA
Palanpur
R. Sabarmati
Khed Brahma
R A N N O F K U T C H
PACHHAM
KHADIR
BELA
RADHANPUR
LAKHPAT
R. Banas
RAPAR
BHACHAU
BHUJ
MEHSANA
MEHSANA
LITTLE RANN
Kharaghoda
KANDLA
Viramgam
AHMADABAD
R. Mahi
MANDVI
DHRANGADHRA
MORVI
KAIRA
WADHWAN
Okha Port
NAVANAGAR
NADIAD
PANCH MAHALS
GODHRA
JHABUA
INDORE
DWARKA
RAJKOT
CHHOTA UDAIPUR
BARODA
GONDAL
BHAVNAGAR
BROACH
BROACH
Rajpipla
R. Narbada
PORBANDAR
JUNAGARH
BILKHA
R. Tapti
MAHUVA
SURAT
Songadh
VERAVAL
Navasari
Diu
BANSDA
DHULIA
THE DANGS
EAST KHANDESH
MALEGAON
DHARAMPUR
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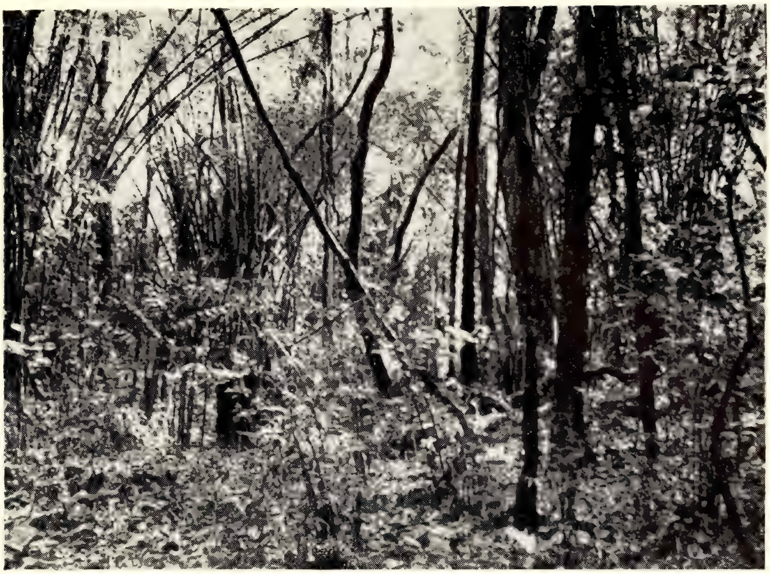
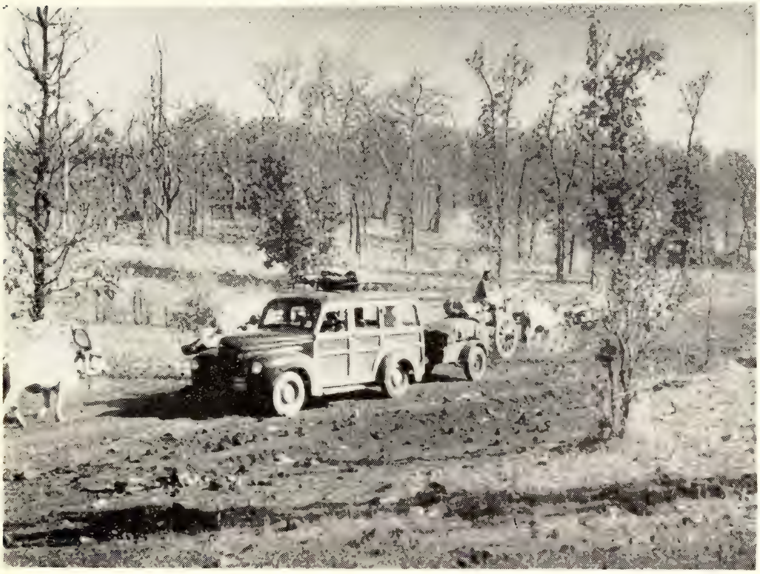
MILES
GUJARAT, 1" = 50 Miles
NASIK
JAWHAR
Deolali

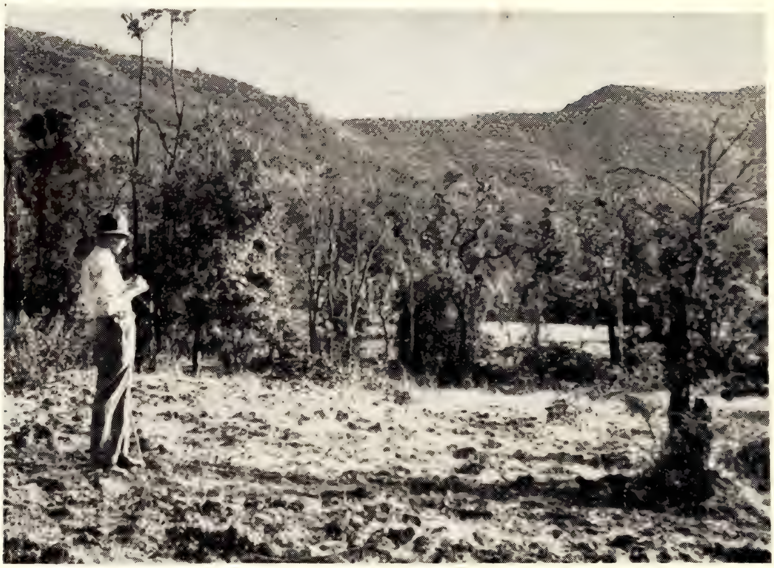


1. Moist deciduous forest, Rajpipla, S. Gujarat

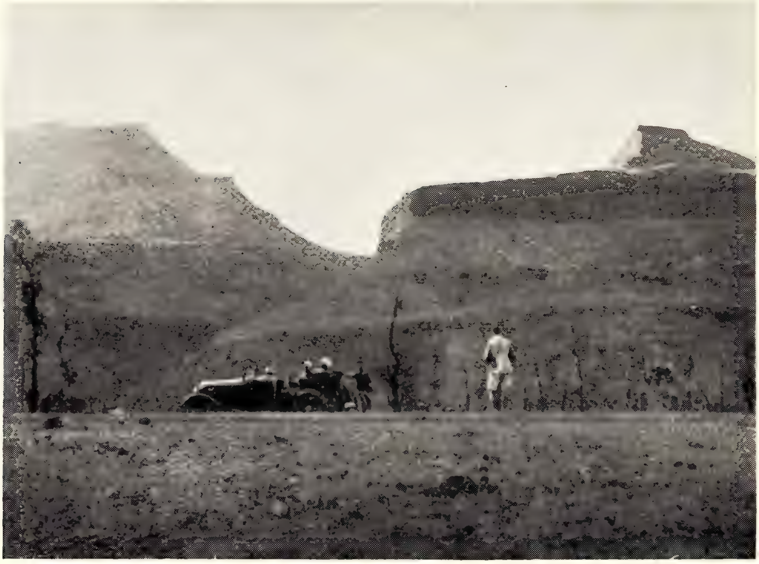


2. Deciduous biotope, Surat Dangs, March

Photos by Author



1. Moist deciduous secondary jungle, Surat Dangs



2. Looking towards Salher Fort, Navsari Dist., S. Gujarat

Photos by Author

Kutch and the Kathiawar peninsula (Saurashtra). It includes also the tract of hilly jungle country south of the Tapti River known as the Surat Dangs which lies between the Nasik-Khandesh Deccan and the south Gujarat plain. This area which may roughly be enclosed within the parallelogram 20°30′ to 24°N and 69° to 74°E, has recently been termed Maha Gujarat or Great(er) Gujarat (*Jour. Gujarat Res. Soc.* vol. ix. (3) p. 155—July 1947), a name whose general adoption is commendable from several points of view.

PHYSIOGRAPHY

Maha Gujarat contains a wide range of biotopes, stretching from practically pure sandy desert (e.g. the Great Rann of Kutch), with an annual rainfall of less than 10 inches, to tropical semi evergreen forest (e.g. portions of Navsari district and the Surat Dangs) with an average annual precipitation of over 80″.

The most prominent trees and shrubs interspersed among cultivation as well as about villages and on the countryside generally are mango (*Mangifera indica*), neem (*Melia azadirachta*), kot (*Feronia limonia*), mhowa (*Bassia latifolia*), ber (*Zizyphus jujuba*), kandi (*Prosopis spicigera*), babul (*Acacia arabica*), tamarind (*Tamarindus indica*), the two Salvadoras (*persica* and *oleoides*), *Gymnosporia montana*, and *Capparis aphylla*, depending upon the requisite locality factors.

It is not easy to classify the terrain as a whole, but three main types are clearly recognisable.

The northern portions, from a little NW. of Ahmedabad city, e.g. the Mehsana, Radhanpur and Palanpur areas stretching up to the Marwar desert are largely flat, undulating, sandy, semidesert tracts with sparse cultivation and tall luxuriant Euphorbia hedges. As it approaches the Abu hills (Aravalis) the country assumes a hilly and stony character e.g. about Hathidhara and Balaram in Palanpur territory. Here it is tolerably well-wooded being covered mostly with scrub jungle, 12 to 15 ft. high, consisting of *Zizyphus*, *Acacia*, *Butea*, *Salvadora*, *Aegle marmelos*, *Gymnosporia* and such other typical species, with a sprinkling of enormous, ancient, spreading Ficus trees, chiefly *F. bengalensis*. Bordering streams are found some lofty arjun trees (*Terminalia arjuna*) and bamboo (sp. ?) is locally abundant on the low hills.

In years of normal rainfall a chain of marshy jheels forms between Ahmedabad and Sidhpur attracting abundant wildfowl. The greater part of the plains or champaign (Central Gujarat), including the erstwhile Baroda State territory are heavily cultivated, the principal crops being bajra (*Pennisetum typhoideum*), jowar (*Sorghum vulgare*), groundnut (*Arachis hypogaea*) and cotton (*Gossypium*). Scattered among the cultivated fields or clustered in groves around the little villages are trees, usually large and leafy, of mango (*Mangifera indica*), neem (*Melia azadirachta*), ‘ teep-papdi ’ (? *Acanthocephalus kadamba*), mhowa (*Bassia latifolia*) and tamarind (*Tamarindus indica*). *Butea frondosa* forms scrub patches here and there along the banks of streams and nullahs, while the tād or palmyra palm (*Borassus flabellifer*) is locally abundant.

The physiography and vegetation of Kutch are in the main similar to N. Gujarat—sandy flat semidesert with a preponderance of xerophytic species. Here and there occur, scattered singly or in clusters, shady trees around villages and tanks, or in the luxuriant ‘ wādis ’ or market gardens irrigated from deep wells. The unique feature of the Kutch landscape, however, and one that calls for special mention is the Great Rann which divides Kutch from Western Pakistan (Sind) to the north. It is an expansive billiard-table-flat strip of salt, barren, sandy waste some 150 miles long east to west, and 80 wide north to south. During the SW. monsoon season the Rann becomes completely inundated, partly by the flood waters of the rivers Banas and Luni debouching into it, and partly by the sea. When the water dries the Rann assumes a hard flat desiccated surface, covered with pebbly stones, shingle and salt encrustation. To the ornithologist the greatest interest of the Rann lies in the unequalled potentialities it offers for the visual observation of bird migration in autumn and spring, and in its being the only known breeding ground of the flamingo (*Phoenicopterus ruber*) in this country, the most easterly in Asia and perhaps the largest in the world. Further details regarding the climate and floristics of Kutch may be found in the Introduction to Sálim Ali : The Birds of Kutch (Oxford University Press, 1945).

The Kathiawar peninsula (Saurashtra) in its physiography is an epitome of Kutch and the rest of Gujarat. The hilly deciduous forest, characteristic of portions of Central Gujarat, finds its parallel in Junagadh (southern Saurashtra), particularly in the Gir which has an annual rainfall of 40 to 50". For an account of the flora of this area reference may be made to the excellent paper recently published by H. Santapau, S.J., and M. B. Raizada (*Indian Forester*, **80** (7), July 1954.

Forest, wherever it occurs, broadly falls into the following four major types of Champion's classification[1]

1. Tropical Thorn Forest (Kutch, Saurashtra, N. Gujarat),
2. Tropical Dry Deciduous (Central Gujarat, Saurashtra (Gir),
3. Tropical Moist Deciduous } (Surat Dangs, Navsari prant, Raj-
4. Tropical Semi-evergreen } pipla)

In the composition of the Dangs forests the principal species is Teak. Some of the other characteristic trees are ain or sadada (*Terminalia tomentosa*), beo or bibla (*Pterocarpus marsupium*), dhaman (*Grewia tiliaefolia*), dhamoda (*Anogeissus latifolia*), kilai (*Albizzia procera*), haldwan (*Adina cordifolia*), khair (*Acacia catechu*), koshim (*Schleichera trijuga*), mahuda or mhowa (*Bassia latifolia*), samar (*Bombax malabaricum*), tanach or tiwas (*Ougeinia dalbergioides*), timru (*Diospyros melanoxylon*) and others. Bamboo is abundant, both the katas (*Bambusa arundinacea*) and manwel (*Dendrocalamus strictus*).

Among the more important scientific results of the ornithological explorations in Maha Gujarat has been the northward extension of a number of forest birds hitherto believed to be restricted only to the humid southern section of the Western Ghats or Sahyadris. Their discovery at the northern end of this mountain chain, in the region where these hills dovetail with the Satpuras (Rajpipla and Khandesh, etc.), provides striking evidence in support of Dr. S. L. Hora's hypothesis concerning the probable route by which East Himalayan fauna, particularly fishes of the hill streams, spread to South India, namely over the Satpura mountain trend. This aspect of the field work in Gujarat has been dealt with more fully elsewhere [Sálim Ali (1948): The Role of the Gujarat Satpuras in Indian Ornithogeography, *Jour. Guj. Res. Soc.*, Vol. 10, pp. 35–45.]

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[1] Champion, H.G.(1936): A Preliminary Survey of the Forest Types of India and Burma. *Ind. For. Rec.* (New Series), Sylviculture. Vol. I, No. 1.

1. Country about Balaram, Palanpur
N. Gujarat
Abu hills in the distance

2. Lesser Flamingos at Banas River mouth,
Little Rann of Kutch

Photos by Author

1. The Banni country, N. Kutch

2. Typical coastal sand-dunes, Mandvi, Kutch

Photos by Author

Some of the peculiar species whose distributional range has now been shown to extend to the Gujarat Satpuras are :

Malabar Trogon (*Harpactes fasciatus*)
Bluebearded Bee-eater (*Alcemerops athertoni*)
Malabar Whistling Thrush (*Miyophoneus horsfieldi*)
Large Wood Shrike (*Tephrodornis gularis*)
Orange Minivet (*Pericrocotus flammeus*)
Blackbacked Pied Shrike (*Hemipus picatus*)
Vigor's Yellowbacked Sunbird (*Aethopyga siparaja vigorsi*)
Malherbe's Goldenbacked Woodpecker (*Chrysocolaptes guttacristatus*)
Heartspotted Woodpecker (*Hemicircus canente*)
Malabar Black Woodpecker (*Dryocopus javensis*)

BIRD MIGRATION

The geographical position of Kutch, Banaskantha and the Kathiawar peninsula and the natural conditions that obtain, particularly in the former two, make them ideal venues for the study of Indian bird migration. Kutch lies directly athwart the main route of the hordes of species that sweep into India from the north and north-west in autumn and out in the reverse direction in spring. It forms, moreover, the eastern fringe of the broad stream of through migration that flows down from Central and Northern Asia in a southwesterly direction in autumn. This current passes over the NW. Frontier Province, Afghanistan, Baluchistan and Sind, beyond across the Arabian Sea and southern Arabia into British Somaliland and Abyssinia, and trickles down the eastern side of the continent even to South Africa. Many of the Asiatic forms that winter in Africa pass through Kutch in September and early October. They come in great waves, as it were ' swarming ', on the countryside during their temporary sojourn, and are all completely gone within the course of a few short weeks. The return passage, in the main at any rate, apparently takes a somewhat different route since the birds are not in such prominence again in spring. Outstanding examples of these Africa-bound ' through passengers ' by the Arabian route are the Greybacked Warbler (*Agrobates galactodes familiaris*), Indian Whitethroat (*Sylvia communis icterops*), Kashmir Roller (*Coracias garrula semenowi*), European Nightjar (*Caprimulgus europaeus unwini*) and Spotted Flycatcher (*Muscicapa striata neumanni*).

Kutch derives a substantial quota of its winter visitors and/or passage migrants into peninsular India from the NW. and WNW., i.e. from northern and eastern Europe and from Middle-Eastern countries. The Rosy Pastor (*Pastor roseus*), Blackheaded Bunting (*Emberiza melanocephala*), Greynecked Bunting (*E. buchanani*), Yarkand Short-toed Lark (*Calandrella brachydactyla longipennis*) and White Stork (*Ciconia c. ciconia*) are some of the species that enter by this route.

Kutch is a veritable crossroads for all these migrational streams, and offers unique opportunities for a well planned study of Indian bird migration by ringing and observational methods. The bare and open nature of the terrain, and the scantiness of vegetation are distinct advantages. Data which otherwise would have to be collected more or less piecemeal and conjecturally, here stand out in graphic clarity. Especially suitable for trapping and observation stations is the northernmost edge of the ' islands ' or ' bets ' where the flat, featureless Rann meets the stony range of hills (Kala Dongar, Bhanjda Bet, Chhaparia etc.) that runs more or less continuously along the northeastern border of Kutch. I can think of no better place than this for the study of visual migration in the whole of India. The wide expanse of the Great Rann that separates Sind from Kutch must of necessity be crossed by all birds journeying along this sector of the route. There are no natural distractions to make them linger, and thus create doubts and uncertainties in the mind of the observer as to whether what he sees is actual migration in progress or not. There is no obstruction to good visibility here save perchance when a dust storm is on. If a few observation posts could be strung out along the northern base of this transverse range of hills—say from Kuar Bet across to Bela Island—manned at the appropriate seasons by competent bird watchers, I am confident that data of the highest value could be secured. While encamped at Nir on the NE. point of Pachham Island during the first 3 or 4 days of October (1943) I found ample assurance of this from the abundance of the species and numbers of birds that were continually passing through.

The late Maharao of Kutch, Shri Vijayarajji, who was keenly interested in birds, had approved of a tentative scheme for the putting up of observation posts along the Great Rann. Owing to his untimely death and the change in the general set-up, the plan unfortunately never reached fruition. When field ornithology in India comes into its own—as one hopes it will do in the not too distant future—the implementation of such a scheme will deserve one of the top priorities.

The classification adopted in the Systematic List that follows is a modified version of Wetmore's well known arrangement which, in essentials, is now more or less internationally adopted. 'A (1952) Revised Checklist of the Birds of Ceylon' by W.W.A. Phillips (published by the National Museums of Ceylon), Dr. B. Biswas's very useful 'Checklist of Genera of Indian Birds' (*Rec. Ind. Mus.*, 50 (1): 1–62) and Dr. S. Dillon Ripley's more complete 'Checklist of Indian Birds' (under active preparation) have all adopted the Wetmore classification with suitable modifications. Moreover, all the recent checklists of birds of our neighbouring countries (Malaysia, Thailand, etc), either published or shortly to be published, follow this system of classification, namely they begin with what is believed to be the lowest rung of the evolutionary ladder and climb to the highest. Thus in the case of Indian birds they begin with the Gaviidae (Divers & Loons) and end with the Corvidae (Crows), and not vice versa as Stuart Baker's Fauna volumes did. The position of individual genera and species within this framework may vary somewhat as between one author and another, but the divergence is usually of minor degree.

Personally I consider it immaterial at which end we begin ; and while naturally I would rather retain an arrangement with which the living generation of Indian bird students is familiar—and on which I was myself brought up—it seems clear that we cannot isolate ourselves from the universal trend which, for better or worse, has largely replaced what is now considered to be an outmoded system. If we wish to keep in close touch with modern ornithological thought and literature, we must of necessity adopt the new classification and familiarize ourselves with it in the shortest possible time. Therefore, the sooner we begin, the better. I trust this apologia will suffice for what some will, I fear, consider a thoroughly unwarranted innovation. A little inconvenience and confusion are inevitable at first, but one soon gets accustomed to change, however drastic, and it may be hoped that in due time the younger generation will find it just as easy to grope their way through the new classification as we did through the old.

In order to facilitate reference, the new sequence in which the families appear in the following pages is given below :

Podicipitidae : Grebes, Dabchick
Pelecanidae : Pelicans
Phalacrocoracidae : Darter, Cormorants.
Ardeidae : Herons, Egrets, Bitterns
Ciconiidae : Storks.
Plataleidae : Ibises, Spoonbill
Phoenicopteridae : Flamingos
Anatidae : Ducks, Geese, Swans
Accipitridae : Hawks, Vultures
Falconidae : Falcons
Phasianidae : Junglefowl, Partridges, Quails
Turnicidae : Button-and Bustard-Quails
Gruidae : Cranes
Rallidae : Rails, Coots
Otidae : Bustards, Florican
Jaçanidae : Jaçanas
Haematopodidae : Oystercatcher
Charadriidae : Plovers, Lapwings
  Subfamily Scolopacinae : Curlew, Sandpipers, Snipe, Woodcock
Recurvirostridae : Stilt, Avocet
Rostratulidae : Painted Snipe
Dromadidae : Crab Plover
Burhinidae : Stone-Curlews
Glareolidae : Coursers, Pratincoles
Laridae : Gulls, Terns
Pteroclidae : Sandgrouse
Columbidae : Pigeons, Doves
Psittacidae : Parakeets
Cuculidae : Cuckoos
Tytonidae : Barn Owl
Strigidae : Owls
Caprimulgidae : Nightjars
Apodidae : Swifts
Trogonidae : Trogons
Alcedinidae : Kingfishers
Meropidae : Bee-eaters
Coraciidae : Rollers or Blue Jays
Upupidae : Hoopoes
Bucerotidae : Hornbills
Capitonidae : Barbets
Picidae ; Woodpeckers
Pittidae : Pittas
Alaudidae : Larks

N.B. Unless otherwise stated all measurements in the account that follows were taken in the flesh; therefore allowance for shrinkage in the wing must be made when comparing with museum material. In my experience this varies from 2 to 4 mm. in the case of birds up to the size of a starling.

SYSTEMATIC LIST

Family PODICIPITIDAE: Grebes, Dabchick.

Podiceps ruficollis capensis Salvadori. The Little Grebe or Dabchick.

Specimens collected: Kutch KS350 ♀ 9-3-44 Mandvi; Gujarat: GS575 ♀ 12-12-45 Saiat (Kaira Dist.)

Measurements:	W	B	Tar.	T
1 ♀ ad.	102	28	34·5	—
1 ♀ imm.	93	20·5	32	23

Resident. Common on all inland still waters. Breeding was in full swing in Kutch during August and September (1943).

Podiceps caspicus caspicus (Hablizl) The Blacknecked Grebe (= *nigricollis*)

A specimen was collected by K. S. Dharmakumarsinhji near Bhavnagar on 7-11-1951. (*JBNHS*, 50: 664). This is the only record of this rare migrant for western India.

Podiceps cristatus cristatus (Linn.) The Great Crested Grebe.

A rare winter visitor. K. S. Dharmakumarsinhji obtained a pair (♂♀) 22/24-8-1947, and saw a third example on a tank in Bhavnagar (*JBNHS*, 47: 385.). The early date is interesting. In the Society's collection there is a specimen from Viramgam, 13-3-1905. Hume records others (*S.F.*, iv : 31) from Deesa, Kutch and the western coast of Kathiawar, at Beyt and Porbunder.

Family PELECANIDAE: Pelicans.

Pelecanus onocrotalus Linn. The Rosy Pelican.

Pelecanus philippensis philippensis Gmelin. The Spottedbilled Pelican.

Pelecanus philippensis crispus Bruch. The Dalmatian Pelican.

Noted: Kutch: Pung Bet (Little Rann) at the mouth of the Banas River. Saurashtra: Mithapur (Okhamandal); Navlakhi. Gujarat: Kharaghoda.

Of the birds observed by the Surveys some were satisfactorily identified as *onocrotalus* and others as *p. philippensis*. It is not unlikely that the large gatherings may have contained *p. crispus* as well since that species is a common winter visitor to Sind and has been noted by Hume on the Rann of Kutch and on the western coast of Kathiawar. But the birds were always so wild that close enough approach for definite diagnosis was seldom possible.

Lester saw about 20 Rosy Pelicans at Devisar Tank (Bhuj Dist. Kutch) in the winter of 1893, and Butler (*S.F.*, iv: 32) records immense flocks of *onocrotalus* on some tanks in northern Gujarat during winter.

He gives an interesting paragraph on their feeding habits, and mentions that *P. philippensis* were equally common, and on the same ground.

Family PHALACROCORACIDAE : Darter, Cormorants.

Phalacrocorax carbo [**sinensis** (Shaw & Nodder)]. The Large Indian Cormorant.

Noted: Kutch: Chobari (Bhachau Dist.); Kandla. Gujarat: Baduchi (Cambay town environs); Kanewal (Cambay) ; Radhanpur.

Small numbers at tidal lagoons, duck-shooting jheels, salt pans, etc.

Phalacrocorax fuscicollis Stephen. The Indian Shag.

Noted : Kanewal (Cambay). Possibly overlooked elsewhere.

Phalacrocorax niger (Vieill.). The Little Cormorant.

No specimens collected.

Noted : Kutch: Bhuj environs ; Mandvi, etc. Saurashtra: Dhari (Amreli Dist.) Ghatwad (Kodinar). Gujarat: Baroda environs and district ; Cambay and environs ; Balaram (Palanpur) Gujarat : Viramgam, etc.

Resident. Common. Breeding in mixed heronries of egrets, etc. in August (Kutch). Normal clutch 4 eggs.

Anhinga melanogaster Pennant. The Darter or Snake-bird.

No specimens collected.

Noted : Kutch: Kandla ; Bhuj environs ; Rapar ; Khadir Island (Great Rann) ; Saurashtra: Dwarka ; Mithapur (Okhamandal) ; Kodinar ; Ghatwad etc. Gujarat: Baroda and environs ; Cambay and environs ; Palanpur, Viramgam, etc.

Resident. Common. In smaller numbers than cormorants, but usually in association with them at tanks and jheels. Breeding in mixed heronry with spoonbills, etc. in August (Kutch).

Family ARDEIDAE : Herons, Egrets, Bitterns.

Ardea purpurea [**manilensis** Meyen]. The Purple Heron.

No specimens collected.

Fairly common resident throughout the area. Frequent, but not abundant. Solos at suitable waters—jheels with reedbeds, tidal mangrove swamps, etc.

Breeding in Kutch in August in mixed heronries with Cattle Egrets, etc. Normal clutch 3 eggs.

Ardea cinerea [**rectirostris** Gould]. The Grey Heron.

Specimen collected : Gujarat: GS245 ♀ 17-11-45 Dabka (Baroda Dist.)

Measurements :	W	B	Tar.	T
1 ♀	417	120	151	150
		(from forehead feathers)		

Apparently this subspecies, but I am not positive.

Same remarks as for the Purple Heron. Breeding in Kutch in August.

Butorides striatus [**javanicus** (Horsf.)]. The Little Green Bittern.

No specimens collected.

Noted: Kutch: Kandla; Saurashtra: Dwarka (Okhamandal), Dhari (Amreli Dist.); Gujarat: Dediapada (Rajpipla); Waghai & Laochali (Surat Dangs).

Solos in bushes bordering streams and tidal mangroves. Largely crepuscular. Doubtless resident, but no data on breeding within the area.

When perched on a low branch, flicks tail like kingfisher, more rapidly.

Ardeola grayii (Sykes). The Pond Heron.

Specimens collected: Gujarat; GS122 ♂, GS123 ♀ 5-11-45 Bodeli (Baroda Dist.) GS522 ♂ 9-12-45 Nadiad environs (Kaira Dist.)

Measurements:	W	B	Tar.	T
2 ♂♂	215–219	57–64	57–60	75–79
		(from forehead feathers)		
1 ♀	206	61	54	59

Common throughout, at ditches, ponds and tanks. Usually singly; occasionally loose parties. Nesting July to September in mixed heronries with egrets and cormorants, etc. Colour of legs variable seasonally and *individually*, from bright yellowish green or sage green (non-breeding) to bright salmon pink or rose pink (breeding).

Bubulcus ibis coromandus (Bodd.) The Cattle Egret.

Specimen collected: GS155 ♂ 7-11-45 Bodeli (Baroda Dist.)

Measurements:	W	B	Tar.	T
1 ♂	263	69	90	97·5

Common throughout, mostly in attendance on grazing cattle. Large numbers collect to roost at night in favourite leafy trees. Breeding in progress July to September. Much harried by House Crows in the mixed heronries who destroy vast numbers of eggs and young, missing no opportunity to lift them from nests howsoever momentarily left unattended.

Bluebottle flies (*Musca vomitoria*) picked off low herbage while following cattle, figure largely in its diet. Poises bill, sways neck from side to side like a snake to take aim, and jabs bill at fly.

Egretta alba modesta (Gray). The Large White Egret.

Specimens collected: Kutch: KS220 ♀ 14-9-43 Tuna (Anjar Dist.); Gujarat: GS236 ♀ 15-11-45 Baroda town environs; GS339 ♀, GS340 ♀ 21-11-45 Dabka (Baroda Dist.); GS517 ♂ 9-11-45 Nadiad environs.

Measurements:	W	B	Tar.	T
1 ♂	372	115	165	135
4 ♀♀	337–365	97–100·5	132–160	120–138

All the specimens are in winter dress so there are no breast plumes to suggest any of them being *intermedia*. The measurements of *modesta* and *intermedia* overlap so considerably, with odd birds shooting up or down from the norm, that identifying individual examples is not always satisfactory. In the field extreme examples of the two are often impossible to tell apart.

A specimen (♀) in the B.N.H.S. collection labelled 'Yonywa, Sandoway Dist. (Burma) 26-2-30'—also in winter plumage and without breast plumes—is determined by Dr. C. B. Ticehurst as *intermedia.* I measure this specimen W 361; B 99, Tar. 136, T 133, therefore far exceeding the wing measurement given for *intermedia* by Stuart Baker: '304–333 mm., once 354' (F.B.I., vi: 347). It falls more satisfactorily within the range of *E. a. modesta,* namely '354–391 mm.' and altogether there seems no doubt that it is misidentified.

Further, as regards colour of bill, according to published descriptions (cf. F.B.I., vi, 345–47) this in the breeding season is black and in non-breeding birds yellow, in both *a. modesta* and *intermedia.* In a heronry off Kandla in the Gulf of Kutch Mr. W.T. Loke and I particularly remarked that a number of actually breeding examples (with nest and young) of *E. a. modesta* had yellow bills! The presence of dorsal plumes and the absence of breast plumes now made their identity undoubted. The bill colour of breeding birds could be a dimorphic character analogous to the colour phases of *Demiegretta asha* or to leg colour in breeding egrets and pond herons (*Ardeola*). It is also possible that the seasonal change in bill colour from yellow to black and vice versa is not perfectly synchronized with the donning and doffing of breeding plumes.

Resident evidently over the entire area. Seen singly, as a rule, at jheels, ponds, marshes, rivers, etc., but its identity is often confused with the Lesser Egret (*E. intermedia*). Nesting was in progress in Kutch (Kandla Creek) in August/September in a mixed heronry among mangrove trees, shared chiefly by Reef Herons.

Egretta intermedia [intermedia (Wagler)]. The Indian Smaller Egret.

No specimens collected.

Observed in Kutch, Saurashtra and Gujarat but sometimes possibly confused with the Large White Egret. When the two species are seen together it is usually possible to differentiate them on size. The Smaller Egret is more gregarious, as a rule, though solitaries are also not uncommon. Breeding was in progress in Kutch during August/September, in mixed heronries.

Egretta garzetta garzetta (Linn.). The Little Egret.

Specimens collected: Gujarat: GS181 ♂ 8-11-45 Bodeli (Baroda Dist.); GS1172 ♂ 31-3-46 Dediapada (Rajpipla).

Measurements:	W	B	Tar.	T
2 ♂♂	285–290	90–93	114–115	103–104

In both the above the legs (tibia and tarsus) are black, and the feet greenish yellow.

Common over the entire area, usually at jheels and on marsh land and inundated ploughed fields, etc. Normally gregarious. Breeding was in full swing in Kutch during August and September, in mixed heronries with Cattle Egrets and Cormorants. Threequarter fledged young are confusable with *Bubulcus* of comparable age, but black bill as against dark yellowish brown in the Cattle Egret is a distinguishing character.

Demiegretta asha (Sykes). The Indian Reef Heron.

Specimens collected: Kutch: KS62 ♀ imm. 13-8-43. Bhuj environs; Saurashtra: ♂ 4-4-47 Okha (coll. Devkar).

Measurements:	W	B	Tar.	T
1 ♂ ad.	277	93	104	104
1 ♀ imm.	265	85	98	85

Common along the sea coast, and about tidal creeks and mangroves. Once seen at a freshwater tank in Kutch. Usually solitary, but nests colonially. Feeds largely on mudfish (*Periopthalmus*). Also wades into shallow surf and 'still hunts' for small fry.

Nesting was in progress in Kandla Creek, Kutch, during August and September on a tide-swept island in a mixed heronry on mangrove trees with Large and Smaller Egrets (*E. a. modesta* and *E. i. intermedia*).

In this colony the majority of birds were slaty blue-black. There was no direct evidence of blue and white birds being paired together. All the nests examined (about 8 out of over 30) contained either exclusively white young (3 or 4 per nest), or exclusively ashy ones. Only in one nest was there a mixture of the two phases—two chicks all-white, one all-grey. At least one of the parents of this brood (observed feeding young) was pure white. None of the white chicks in the colony were ever *pure* white, all being dappled grey to a greater or lesser extent. (Is the juvenile plumage also dimorphic, or do only the dappled white young turn into the white adult phase and the ashy become darker with subsequent moults?)

In recently hatched chicks the naked body skin—the apteria, and also in between the feather-buds—is yellowish grey-green; legs and feet yellowish green and brown. Bill dark brown with a greenish tinge. Iris greenish grey in very young chicks; lighter coloured—almost whitish grey—in older ones.

Nycticorax nycticorax nycticorax (Linn.). The Night Heron.

Specimen collected: Gujarat: GS1175 ♀ + 31-3-46 Dediapada (Rajpipla).

Noted: Kutch: Bhuj environs; Kandla; Tuna; Lakhpat, etc. Gujarat: Baroda city and environs; Kanewal (Cambay); Viramgam.

Measurements:	W	B	Tar.	T
1 ♀	293	65	73	109

Resident. Not common and rather locally distributed. Crepuscular and nocturnal. Breeding in Kutch during August and September in mixed heronries. Apparently breeds in Gujarat at other seasons also; the specimen of March 31 had the oviduct distended and the largest ovarian follicles measured 2 mm.

Ixobrychus sinensis [sinensis (Gmelin)]. The Yellow Bittern.

Not met with by the Surveys. Butler (*S.F.*, v: 216) found two or three pairs breeding in bulrushes by a small tank at Milana near Deesa during the rainy season—August 1876.

Botaurus stellaris [**stellaris** (Linn.)]. The Bittern.

Not met with by the Surveys. Butler (*S.F.*, iv : 24, 1876) records it as occasionally seen and shot at some reedy tanks in N. Gujarat in winter. He mentions one such tank at Milana, about 18 miles NE. of Deesa.

Family CICONIIDAE : Storks.

Ibis leucocephalus leucocephalus (Pennant). The Painted Stork.

No specimen collected.

The commonest stork in the area, found in ones and twos or large gatherings at jheels, ponds, marshes etc., and sometimes also at streams and tidal creeks. Breeds in August/September in large colonies on trees standing in or near water, usually in a mixed heronry. Feeds in shallow water, jabbing the partly open bill into the ooze, sometimes right up to the gape. One leg is raised and kicked forward, a little behind and to one side of the bill, and deliberately shaken with a raking motion, to drive the quarry into the mandibles. From time to time one wing is flicked open in an attempt to stampede the 'frozen' quarry ; and that this manoeuvre usually succeeds is apparent from the bird's subsequent movements—the sudden snapping of the mandibles, jerking upwards of the head and swallowing.

Anastomus oscitans (Bodd.). The Openbilled Stork.

No specimen collected.

Not uncommon, throughout the area as a whole, but not abundant, and subject to considerable local movements dependent on the monsoon. Seen in twos and threes or small flocks at jheels and marshes.

Ciconia episcopa episcopa (Bodd.). The Whitenecked Stork.

Specimen collected : Gujarat: SD212 ♂ 7-3-48 Chinchli (Surat Dangs) ; GS644 ♂ 19-12-45 Vaghjipur (Mehsana Dist.)

Elsewhere noted : Gujarat: Bodeli (Baroda Dist.) ; Dediapada (Rajpipla) ; Mahal, Galkund, Mheskatri (Surat Dangs).

Measurements :	W	B	Tar.	T
2 ♂♂	515–519	163–171	184–185	162–190

Iris brown ; bill black, red on culmen and gonys, at tips of both mandibles and along commissure ; legs and feet lake red.

Resident in Gujarat. Not uncommon, but sparse and local. Singly or pairs at ponds and ditches, etc. Roosts at night up in branches of tall trees. Stomach of one contained larvae of water beetles and a fish 3″ long. Not met with by the Kutch Survey though Lester records it 'during the cold season and rains.' Local Mahratti name Kardōk.

Ciconia ciconia ssp. The White Stork.

Observed only on three occasions in Gujarat (January and March) at Deesa (Palanpur) and in the Surat Dangs at Pimpri and Mheskatri—solos and parties of 3 or 4. Apparently an uncommon winter visitor.

Ciconia nigra (Linn.). The Black Stork.

Not observed by the Surveys. Lester records it in Kutch during the cold weather. Butler (*S.F.*, IV : 22–1876) noted one on a tank between Ahmedabad and Deesa, and it may well occur in other parts of the area also in winter season.

Xenorhynchus asiaticus [asiaticus (Lath.)]. The Blacknecked Stork.

No specimen collected.

Noted: Kutch: Kandla; Bhuj environs; Anjar. Saurashtra: Dwarka (Okhamandal); Gujarat: Dabka (Baroda Dist.); Saiat (Kaira Dist.); Viramgam.

Resident. Sparse. Occasional solos at tanks, etc. On September 10 (1943—Kandla, Kutch) a bird was observed sitting on an empty but fresh nest on a mangrove tree-top amongst a mixed heronry on an islet in Kandla Creek.

Leptoptilos dubius (Gmelin). The Adjutant.

Leptoptilos javanicus (Horsf.). The Smaller Adjutant.

Not met with by the Surveys. The late Sir Peter Clutterbuck, I.F.S. reported seeing both species in Kutch during the winter of 1944/45, the former near Bhuj, the latter at Mandvi.

Butler (*S.F.* iv : 21—1876) considered the former rare in northern Gujarat. He saw occasional solos and small parties of 3 to 8 birds (August and November) usually feeding with vultures at animal carcases, but apparently did not meet the Smaller Adjutant.

Family PLATALEIDAE: Ibises, Spoonbill.

Threskiornis melanocephalus (Latham). The White Ibis.

Specimen collected: Gujarat: GS548 ♂ 12-12-45 Saiat (Kaira Dist.)

Noted: Kutch: Mandvi; Bhuj and environs; Kandla Khavda; Dholovira (Khadir I.), etc. Saurashtra: Mithapur (Okhamandal). Gujarat: Baroda district; Cambay district; Vaghjipur (Mehsana Dist.); Viramgam; Kharaghoda, etc.

Measurements :	W	B	Tar.	T
1 ♂	381	185 (from forehead feathers)	119	129

Resident. Rather local, but in small numbers usually at tanks, etc. Breeding in mixed heronry of Painted Storks, cormorants etc., August-September (Kutch). When probing into the bottom mud in shallow water, the head is sometimes completely immersed momentarily.

Pseudibis papillosus (Temminck). The Indian Black Ibis.

Specimens collected: Gujarat: GS1272 ♂+ 16-4-46 Mahal (Surat Dangs); SD343 ♀ imm. 16-3-48 Mheskatri (Surat Dangs).

Elsewhere noted: Kutch: Kandla; Mandvi; Bhuj; Chobari (Bhachau Dist.); Saurashtra: Veraval (Junagadh); Kodinar; etc. Gujarat: Viramgam; Bodeli (Baroda Dist.); Vaghjipur (Mehsana Dist.); Radhanpur.

Measurements :	W	B	Tar.	T
1 ♂	401	152	78	190
1 ♀ imm.	390	140	82·5	182

The female was a young bird in the brown plumage, except for the remiges and rectrices which were adult and freshly moulted, glistening blue-black.

Resident. Not uncommon. In family parties and flocks of up to 20 or so. Feeds in dry fallow fields etc., often far from water. Has accustomed roosts in large trees to which flocks repair nightly. Utters a loud, nasal, screaming cry of 3 or 4 notes resembling the Brahminy Duck's. On November 5 (1945—Bodeli) a nest was found *ca.* 80 ft. up among the snags of cut-away leaves in the head of a palmyra palm, containing 3 hard-set pale bluish green eggs. While one bird was incubating, its mate continued to fetch twigs and add them to the nest.

Plegadis falcinellus [**falcinellus** (Linn.)]. The Glossy Ibis.

No specimens collected.

Noted : Kutch : Bhuj (March & April, 1944 and 1945); Gujarat; Viramgam and Kharaghoda (March 1946).

Status uncertain. I cannot trace the source of Stuart Baker's statement (F.B.I., vi : 319) that it breeds in the Rann of Kutch, nor was I able to obtain supporting evidence. This locality has been subsequently omitted by him from ' Nidification ' (iv : 440/1).

On one occasion a flock of over 40 was observed feeding on the edge of a tank. The birds waded in up to the belly and often had their heads completely submerged.

Platalea leucorodia [**major** Temm. & Schleg.)]. The Spoonbill.

No specimens collected.

Noted : Kutch : Bhuj and environs; Mandvi; Kandla; Chobari (Bhachau Dist.) etc. Saurashtra : Dwarka ; Mithapur (Okhamandal); Gujarat: Viramgam ; Dabka (Baroda Dist.) ; Cambay town environs ; Saiat (Kaira Dist.) ; Deesa (Palanpur) ; Kharaghoda etc.

Resident. Common. Breeding in mixed heronries with egrets, cormorants etc., August-September (Kutch).

Family PHOENICOPTERIDAE : Flamingos.

Phoenicopterus ruber roseus (Pallas). The Flamingo.

Specimens collected : Kutch : KS205 ♂ 11-9-43 Kandla. Saurashtra: 3 ♀♀ 4-4-47 Mithapur, Okhamandal (coll. Devkar).

Elsewhere noted : Kutch : Nir (Pachham I., Great Rann); Mandvi ; Pung Bet (Little Rann); Saurashtra : Dwarka (Okhamandal).

Measurements :	W	B	Tarı.	T
1 ♂ ad.	464	134	324	167
3 ♀♀ ad.	393–410	116–126	261–284	130–140

Resident. Widely dispersed on jheels, brackish lagoons, salt pans and sea coast throughout the year and concentrating to breed on the Great Rann off Nir (Pachham Island) in vast numbers. The breeding season varies with the availability of requisite conditions. Normally it is September / October, but in 1945 nesting was at its height as late as March / April. The nest ' city ' covered an area of about 100,000 square yards with an average density of 131 nests per hundred square yards. The number of adult birds present in this colony was estimated at 2,09,516 and the young 69,839, and the total population of flamingos including young and non-breeding birds concentrated in the area was probably not less than half a million. For further details see *JBNHS*, 45 (4): 586–593.

Phoeniconaias minor (Geoffr.). The Lesser Flamingo.

No specimens collected.

Noted: Kutch: Kandla; Nir (Great Rann); Pung Bet (Little Rann); Saurashtra: Mithapur (Okhamandal).

Presumably resident. Usually seen in small parties by themselves or in association with the larger species. Between 25 February and 2 March 1946, enormous concentrations roughly estimated as close on a hundred thousand birds, with no admixture of *ruber*, were observed on the flat muddy expanse of the shallow Banas River near its mouth (opposite Dhutari Bet) in the Little Rann of Kutch. The species has so far not been found breeding within Indian limits, but there seems high probability of its doing so in the Great or Little Rann. The gathering here included numerous birds in the brown post-juvenal plumage perhaps not more than 2 or 3 months old, which could well be from this undiscovered breeding ground. The birds were feeding with great avidity in the bottom, ooze. A sample of mud collected at the actual spot, *ca* ·25 cubic foot, when washed and strained produced only 3 red worm-like larvae *ca.* 5 mm. long each (*Chironomus ?*). The mud was soft and velvety to the touch, of a clayey texture with no grit in it at all nor any visible organic substances. It was reminscent of the oily sludge that collects in the bottom of the crankcase of a motor engine. This ooze is obviously extraordinarily rich in organic matter, since besides this immense gathering of Lesser Flamingos it afforded sustenance to hundreds of thousands of ducks and waders, all concentrated here prior to emigration.

Family ANATIDAE: Ducks, Geese and Swans.

Anser anser [rubrirostris Swinhoe]. The Grey Lag Goose.

No specimens collected.

According to the late Maharao Shri Vijayarajji (*JBNHS*, 21: 678-9) the Grey Lag was a regular winter visitor to Chhari Dhandh (36 miles NW. of Bhuj) in past years and provided good sport. Owing to scarcity of rain and the consequent progressive desiccation since 1930 or thereabouts, the Dhand has apparently disappeared and with it the wintering geese. (Sàlim Ali: The Birds of Kutch, p. 158).

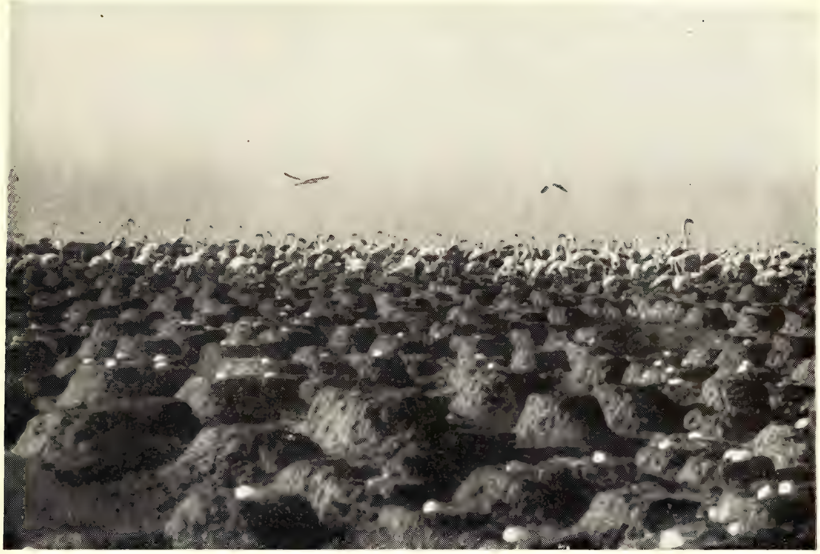
Butler (*S.F.*, iv: 26—1876) recorded it as rare in northern Gujarat. In the neighbourhood of Ahmedabad. 'Very scarce. Seldom more than 1 or 2 shot in a season.' (R. M. Simmons *ca.* 1932). Observed by Dr. H. C. Aldrich is December and January 1931/32 and 1939 at Pariej and Chitersumba (Kaira Dist.)

Anser albifrons [albifrons (Scopoli)]. The Whitefronted Goose.

No specimens collected. Evidently a rare winter straggler. Lester shot 3 birds in February 1892 on a dirty village tank near Anjar (Kutch).

Anser indicus (Latham). The Barheaded Goose.

No specimens collected. According to the late Maharao Vijayarajji (*JBNHS*, 21: 678) a rare winter visitor to Kutch. The surveys did not



1. Portion of 'Flamingo City — Great Rann of Kutch
April 1945

2. Exhausted immigrating Grey Quail sheltering under
old flamingo nest-mound,
Great Rann of Kutch

Photos by Author

come across it in Gujarat or Saurashtra, nor has it been recorded by Hume or Butler or more recent observers.

Cygnus bewickii jankowskii Alpheraky. Alpheraky's Swan.

Specimen : o ? 8-4-1947 Bhuj, Kutch (lat. 23° 15′ N) coll. H. H. Maharao Madansinhji

Measurements :		W	B	Tar.	T
(in flesh)	o ?	552	99 (from forehead feathers)	112	161

Middle toe with claw 140 mm.

One of a pair reported to have frequented Hamirsar tank, within the town of Bhuj, since 4 or 5 days prior to its being picked up disabled on the shore, presumably due to attack by a small crocodile. (*JBNHS*, 47 (3) : 167). A unique record.

In 1870 or thereabouts Stoliczka claimed to have seen some swans while crossing the Great Rann from Kutch to Pachham Island, (*J.A.S.B.*, xli, 1872). Later Hume (*S.F*, iv ; 33, 1876) suspected that Stoliczka, who was known to be short sighted, had probably mistaken pelicans in the distance for swans !

Dendrocygna javanica (Horsf.). The Lesser Whistling Teal.

No specimens collected. Resident. Fairly common locally, but not abundant. Breeding was in progress in Kutch during August (1943).

Dr. H. C. Aldrich of Nadiad found a nest in a hollow in a banyan tree near the village tank of Sandhana (Kaira Dist.) on 1 Sept. 1945, containing 17 eggs believed to be the product of a single female. (*JBNHS*, 45 : 610).

Dendrocygna bicolor (Vieillot). The Larger Whistling Teal.

Not met with by the Surveys. Included in Palin's original list of the birds of Kutch. Ticehurst (*Ibis* 1923 : 457) says 'it is less common in Kutch also than the next species (*D. javanica*).'

I have not been able to trace any authentic records for Kutch or Gujarat, but there is of course no reason why it may not occur.

Tardorna ferruginea (Vroeg). The Ruddy Sheldrake or Brahminy Duck.

No specimens collected. A rare and erratic winter visitor to Kutch ; less uncommon in Gujarat, though never abundant. Usually in twos and threes ; once a loose flock of about 20 (Mahi River, Dabka, Baroda Dist.) Always excessively wary and wide awake.

Todorna todorna (Linn.). The Sheldrake.

A very rare winter visitor, or vagrant. Col. C.B. O'Brien shot one near Bhachau (Kutch) in 1921, and it has been obtained also in Saurashtra (*JBNHS*, 26 : 674).

Anas angustirostris Menetries. The Marbled Duck.

M. K. S. Fatehsinhji shot one in Kutch in 1940, and it has also been obtained in Saurashtra (*JBNHS*, 38 : 195). According to Butler (*S.F.*, iv : 30—1876) though far from common in northern Gujarat, the species occurs on many of the tanks. It is fairly common in Sind.

Anas acuta acuta Linn. The Pintail.

Specimens shot. Winter visitor ; fairly common and plentiful. Often flocks comprised more or less exclusively of drakes.

Anas crecca crecca (Linn.). The Common Teal.

Specimens shot. Winter visitor ; common and plentiful. One of the earliest ducks to arrive : first date August 28 (1943—Kutch). Often in large flocks. Enormous concentrations were observed on the shallow expanse of the Banas River near its mouth in the Little Rann of Kutch in early March (1946), together with many other species, notably the Garganey, presumably just before emigration.

Anas falcata Georgi. The Bronzecapped or Falcated Teal.

Vagrant. A specimen was shot by the late Maharao Vijayarajji in Kutch on 7 February 1932 (*JBNHS*, 35 : 899).

Anas poecilorhyncha poecilorhyncha Forster. The Spotbill or Grey Duck.

Specimen collected : Kutch : KS223 ♀ + 15-9-43 Anjar.

Elsewhere noted : Kutch : Mandvi, Rudra Mata (Bhuj Dist.). Gujarat : Timbi (Baroda Dist.) ; Dakor & Saiat (Kaira Dist.) ; Kharaghoda.

Measurements :	W	B	Tar.	T
1 ♀	269	64	48	94

Resident. Breeds in Kutch during August and September. The specimen was laying. The largest ovarian eggs measured 19 × 15 mm. and the oviduct was greatly distended.

Anas platyrhyncha Linn. The Mallard.

No specimens collected. An uncommon but regular winter visitor ; rather more plentiful in abnormally cold winters. 'Confined to the reedier jheels'. (R. M. Simmons).

Anas strepera Linn. The Gadwall.

Specimens shot. Winter visitor. Common.

Anas penelope Linn. The Wigeon.

Specimens shot. Winter visitor ; fairly common and plentiful. According to Lester it arrives in Kutch later than most other species of duck.

Anas querquedula Linn. The Garganey or Bluewinged Teal.

Specimens shot. Winter visitor ; common and abundant. According to Lester it arrives in Kutch later than the Common Teal. It is also one of the latest to leave, and he records a party of 7 as late as May 6 (1897—*JBNHS*, 11 : 168).

Spatula clypeata (Linn.). The Shoveler.

Specimens collected : Gujarat : GS1047 ♀ 20-3-46 Kharaghoda.

Measurements :	W	B	Tar.	T
1 ♀	236	75	37	79

Winter visitor ; common and abundant. Also amongst the last ducks to leave. I have seen them in numbers till 24th April and Lester records 20 on a tank in Kutch as late as May 6 (1897—*JBNHS*, 11 : 168).

Netta rufina (Pallas). The Redcrested Pochard.

Noted in Gujarat at Patan (Mehsana Dist.). Only a couple, so presumably an uncommon winter visitor. Butler (*S.F.*, iv : 30—1876) writes of it as not very common in northern Gujarat, but occurring on most large tanks.

Aythya ferina (Linn.). The Pochard or Dun Bird.

Seen in small numbers in Kutch and Gujarat. Winter visitor. Fairly common.

Aythya nyroca (Güldenstädt). The White-eyed Pochard.

Specimens shot. Winter visitor ; common.

Aythya fulgiula (Linn.). The Tufted Pochard.

Specimens shot. Winter visitor ; fairly common, but its abundance varying from year to year.

Aythya marila marila (Linn.). The Scaup Duck.

A rare vagrant. One was shot by K. S. Dharmakumarsinhji near Bhavnagar (Saurashtra) on 22nd February 1935 (*JBNHS*, 38 : 195).

Nettapus coromandelianus (Gmelin). The Cotton Teal.

Specimens seen : Kutch : 2 ♀♀, winter 1937, Bhimasar Tank (Anjar Dist. Shot by M.K.S. Fatehsinhji & Sir G. Archer).

Noted : Kutch : Bhuj (Humayun Abdualali) ; Gujarat : Harni (Baroda environs) Saiat (Kaira Dist.)

Measurements : 2 ♀♀ W 151–160 ; Tail 62–64.

Hume (*S.F.*, iv, 27) records it as occurring in 'Kattiawar'. Resident in small numbers. Also local migrant. Breeds July to September.

Sarkidiornis melanotus melanotus (Pennant). The Nukta or Comb Duck.

No specimens collected.

Noted : Kutch : Mandvi (Changdai tank) Rudra Mata (Devisar tank) Bhuj environs ; Gujarat: Pariej (Kaira Dist.) ; Vaghjipur (Mehsana Dist.) ; Champaner (Godhra Dist.)

Resident, in small numbers. According to Hume (*S.F.*, iv: 27) 'Common in Kathiawar'. Lester records it as breeding in Kutch during the rains in holes in cliffs. Normally it nests in tree-holes.

Mergus albellus Linnaeus. The Smew.

Butler (*S.F.*, iv: 31–1876) saw it occasionally on some tanks in northern Gujarat. He describes it as very uncommon and excessively shy. It has not been recorded from Kutch or Saurashtra.

Family ACCIPITRIDAE : Hawks Vultures etc.

Elanus caeruleus vociferus (Latham). The Blackwinged Kite.

Specimens collected ; Gujarat: GS41 ♀ 30-10-1945, GS49 ♂, GS50 ♀ 31-10-45. Ajwa (Baroda Dist.) ; GS571 ♂ 21-12-45 Saiat (Kaira Dist.) ; GS639 ♂ 18-12-45, GS672 ♀ 20-12-45 Vaghjipur (Mehsana Dist.) ; GS820 ♀ 4-1-46 Radhanpur. Elsewhere noted : Kutch : Mandvi ;

Jakhau ; Bhuj environs ; Bela Island (Great Rann) ; Anjar ; Gagodar etc. Saurashtra: Ghatwad (Kodinar) ; Kharaghoda ; Gulkund (Surat Dangs).

Measurements :	W	B	Tar.	T
3 ♂♂	270–276	20·5–23	35–37	120–122·5
3 ♀♀	274–283	22·5–23	35–36	125–130

Fairly common, but sparse and local. Affects dry scrub-and-grass country in open cultivation and waste land. A colony had its roost in a small leafy *Pithecolobium saman* tree in the compound of Ajwa Rest House (Baroda Dist., 30 October). Fifteen or more birds would converge on this from all points of the compass over the surrounding expanse of tall grass every evening at dusk. In fading light the wing action of an oncoming bird is ' angular ' and reminiscent of a flying fox. Stomachs of specimens contained remains of field mice and rats. The gonads of GS41, GS49 and GS50 (30–31 October) were slightly enlarged, but not sufficiently to provide any indication of the breeding season.

Pernis ptilorhynchus ruficollis Lesson. The Crested Honey Buzzard.

Specimens collected. Kutch: KS 330 ♀ 3-3-1944 Bhuj ; Gujarat: GS755 ♀ 30-12-45, GS772 ♀ 31-12-45, GS823 ♀, GS824 ♂, GS825 ♂, 4-1-1946 Radhanpur ; GS873 ♂ 11-1-46, GS901 ♂ 13-1-46 Deesa (Palanpur).

Elsewhere noted : Balaram (Palanpur) ; Mahal (Surat Dangs).

Measurements :	W	B	Tar.	T
4 ♂♂	382–404	36–38	49–57	245–262
4 ♀♀	400–445	38·5–42	55–69	250–276

This series contains examples in every phase of coloration from dark, more or less uniform umber brown below (as in the dark form of *Aquila rapax vindhiana*) with broad brownish grey band in tail (anterior to the black subterminal band), to almost white below with broad or narrow dark brown streaks along the shafts of the feathers on the breast and underparts, and wavy narrow bars and mottling of grey and brown in the tail. In this latter plumage the underparts resemble one phase of *Hieraëtus pennatus*, a bird of rather similar proportions. The deeper, stronger bill, feathered legs and absence of scale-like feathers on lores, forehead and cheeks, and the unbarred under aspect of the tail distinguishes the Booted Eagle from the honey Buzzard in this comparable colour phase.

In some of the Gujarat specimens the whitish underparts are barred with broken brown bands ; in others the underparts are brown similarly cross-barred with white. The dark brown shaft streaks are present in both phases. Whether any of my specimens belong to the typical race of Java or to the Siberian *orientalis* it is not possible to determine for want of suitable comparative material. It would appear that wing size and ' tail-wing index ', $\frac{(t \times 100)}{w}$ are the ultimate criteria between the races. The tail-wing index of the specimens ranges between 62 and 64.8, therefore conforming with Stresemann's dictum[1] that the tail-wing index of *ruficollis* is usually under 65.

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[1] *Archiv für Naturgeschichte*, 1940 : 137-193.

I find, however, that determination of the races satisfactorily with any degree of confidence is by no means a simple matter. Honey Buzzards were common in the Radhanpur area during the last week of December 1945 and the first week of January 1946. A congregation of 8 or 10 birds roosted in large neem and other trees in Jorawar Bagh on the outskirts of the town, and others similarly in the compound of Lalbagh Palace, within municipal limits. It is just possible that all 3 races, or at least one other besides *ruficollis*, were represented in these gatherings. My notes show that of the 3 specimens collected on 4-1-1946, two with many narrow cross-bars in the tail were also very fat, whereas the third which had the typical broad grey-and-black banded tail of *ruficollis* was not. The same was noted in the rest of the specimens: birds with narrow tail bars were fat; those with the broad bands lean, suggesting that the fat birds belonged to the migratory Palaearctic species.

The call-note uttered as the birds flew about was a rather kitelike long-drawn whistling *whee-eew*. Presumably it was also this same call that was once heard during night in the Surat Dangs subsequently, and if it can be confirmed that *Pernis* sometimes does call during the night then the mysterious 'owl' referred to in my Central India Ornithological Survey Report (*JBNHS*, 41; 475) was probably no other than this species.

Milvus milvus (Linn). The Red Kite.

No specimen obtained. Over 50 of these birds collected for scraps in the neighbourhood of my camp on Pung Bet (near Adesar, Little Rann) Kutch (March 1945) where several specimens of wild ass for the British Museum were being skinned. This kite has not hitherto been recorded from Indian limits, but close examination through glasses, several days running, left no doubt whatsoever of its identity. The overall rust-brown coloration with paler (whitish) head, dark-streaked brown breast, the very bright rufous tail and white underwing patch were quite diagnostic. The squealing whistle was similar to the Pariah Kite's, but shriller.

It is probable that the Red Kite is a regular winter visitor to Kutch but has been overlooked, though its deeply forked rufous tail would seem sufficiently distinctive.

Milvus migrans govinda Sykes. The Common Pariah Kite.

Specimens collected: Gujarat: GS234 ♀ + 12-11-45 Bodeli (Baroda Dist.); GS913 ♂ 13-1-46 Deesa (Palanpur); GS1081 ♀ + 21-3-46 Kharaghoda.

Measurements:	W	B	Tar.	T
1 ♀ ad.	458	37	53	290

A common resident in Kutch, Saurashtra and Gujarat. Usually about towns and villages and herdsmen's encampments, and wherever the prospects of refuse and garbage are promising. Breeding from September to end March.

Haliastur indus indus (Boddaert). The Brahminy Kite.

Specimens collected: Gujarat: GS375 ♀ 23-11-45 Dabka (Baroda Dist.).

Elsewhere noted: Kutch: Chaduva (Bhuj Dist.); Anjar

Gujarat: Ajwa, Bodeli (Baroda Dist.); Balaram (Palanpur); Juna Rajpipla; Dediapada (Rajpipla); Mahal (Surat Dangs).

Not common, but usually present on the larger rivers and streams. Breeding was in progress during April.

Accipiter badius dussumieri (Temm. & Laugier). The Indian Shikra.

Specimens collected: Kutch: KS69 ♂ 16-8-43, KS70 ♀+ 17-8-43 Chaduva (Bhuj Dist.); Gujarat: GS77 ♀ 1-11-45 Ajwa (Baroda Dist.); GS179 ♂ 9-11-45 Bodeli (Baroda Dist.); GS306 ♀ 19-11-45, GS357 ♀ + 21-11-45 Dabka (Baroda Dist.); GS390 ♂ 27-11-45, GS445 ♂ 1-12-45, GS497 ♀ 6-12-45 Cambay town environs; GS914 ♀ 14-1-45 Deesa (Palanpur); SD39 ♂ 26-2-48 Galkund; SD47 ♀ 27-2-48 Malegaon; SD129 ♂ 2-3-48 Galkund; SD160 ♂ 5-3-48 Pandwa; SD139 ♀ 3-3-48 Galkund; SD295 ♂ 14-3-48 Mahal; SD390 ♀ 20-3-48 Sarwar (SD series = Surat Dangs).

Measurements:	W	B	Tar.	T
7 ♂♂	179–206	18·5–21	50–54	137–166
8 ♀♀	206–222	21·5–23	51–55	160–175

The commonest of the smaller hawks. Affects wooded country generally. Its favourite haunts are groves of trees in the neighbourhood of villages and cultivation. General moult in August and also in March—body, rectrices, remiges. No direct evidence of the breeding season was obtained, though Lester gives it as March/April for Kutch. Stomachs examined contained remains of skinks, large insects and small birds.

Accipiter nisus nisosimilis (Tickell). The Asiatic Sparrow-Hawk.

Specimens collected: Gujarat: GS441 ♂ 30-11-45 Cambay town environs; GS1171 ♀ 31-3-46 Dediapada (Rajpipla); GS1311 ♂ 21-4-46 Galkund (Surat Dangs).

Measurements:	W	B	Tar.	T
1 ♂ ad.	207	19	59	150
1 ♂ sub-ad.	202	18·5	56	151
1 ♀ ad.	233	22	60	175

Winter visitor. Not common, but may easily be confused with the shikra to which it is superficially very close. Stomach of one contained remains of a Yellowthroated Sparrow (*Gymnorhis*).

Butler (*S.F.*, iii: 445) found it sparingly in the plains and hills of Northern Gujarat in winter. Hume saw a specimen shot by Stoliczka in Kutch, and mentions that it is apparently very rare in 'Kattiawar'.

Accipiter virgatus ssp.

Hume mentions that Stoliczka obtained a couple of young birds in Kutch (*S.F.*, iii : 445–1875).

Buteo [**rufinus** (Cretzschmar)]. The Buzzard.

Specimens not obtained.

Noted: Kutch: Anjar; Thoriari (Wagad Dist.). Not in Gujarat or Saurashtra—possibly overlooked.

A sparse winter visitor to Kutch, much commoner in some years than in others. The heavy build and somewhat sluggish habit, together with the overall reddish brown plumage, buff coloured rounded tail and buff underwing patches provide clues to its identity when perched and in overhead flight.

Butler (*S.F.*, iii : 447) says it arrives in northern Gujarat about 12th September, and is not very common.

Butastur teesa (Franklin). The White-eyed Buzzard.

Specimens collected : Gujarat: GS95 ♀ 2-11-45 Ajwa (Baroda Dist.); GS128 ♀ 5-11-45, GS180 ♀ 9-11-45 Bodeli (Baroda Dist.); GS367 ♀, GS368 ♂ 22-11-45 Dabka (Baroda Dist.); GS460 ♀ 2-12-45 Golana (Cambay); GS523 ♂ 9-12-45 Nadiad town environs (Kaira Dist.); GS719 ♀ 25-12-45 Patan (Mehsana); SD145 ♂ + 4-3-48 Pandwa (Surat Dangs).

Elsewhere noted : Kutch: Mandvi ; Jakhau ; Bhuj. Saurashtra: Dhari (Amreli Dist.) Kodinar ; Ghatwad ; Dalkhania.

Measurements :	W	B	Tar.	T
3 ♂♂	292–304	28–31·5	62–67	169–180
6 ♀♀	295–312	29·5–32	(55)61–68	170–185

The commonest hawk in the area. Affects dry, open, cultivated and sparse scrub-and-bush country ; usually seen perched on a tree-top or pole. Its food is chiefly snakes, lizards, mice and large insects. From the crop of one a watersnake, *Tropidonotus stolatus*, 15 inches long was removed. Another was observed walking about purposefully over a patch of recently burnt grassland, with some of the rubbish still smouldering, looking no doubt for freshly roasted lizards etc. ! Breeding was in progress in March.

Spizaëtus cirrhatus cirrhatus (Gmelin). The Crested Hawk-Eagle.

Specimens collected : Gujarat: GS1129 ♀ 27-3-46 Juna Rajpipla ; GS1170 ♂ 1-3-46, GS1188 ♀ 3-4-46 Dediapada (Rajpipla).

Elsewhere noted : Galkund (Surat Dangs)

Measurements :	W	B	Tar.	T
1 ♂	392	35	106	277
2 ♀♀	410–445	41	105–106	286–335

No. GS1129, apparently subadult, has a buffy or brownish white head; crest normal black with white apical edge. Underparts uniform buffy white with faint, sparse, fine brown shaft streaks on breast. Tips and inner webs of greater upper wing coverts largely buffy white.

Not uncommon in forested country. Usually solos perched bolt upright on outgrowing branches, hidden in the canopy foliage of tall trees whence it can keep a good lookout over a natural glade or cultivation clearing for prey venturing into the open. One observed in aerial display on 1 April (1946), high up in the air, stooping with great velocity and 'looping the loop' completely. No more precise data as to breeding were obtained.

Hieraëtus fasciatus fasciatus (Vieillot). Bonelli's Eagle.

Specimens collected : Kutch: KS338 ♀ 7-3-1944 Bhuj. Gujarat: GS735 ♂ + 27-12-45 Patan (Mehsana Dist.); GS892 ♂ 12-1-46 Deesa (Palanpur) ; GS319 ♀ 20-11-45 Dabka (Baroda Dist.)

Elsewhere noted: Kutch: Chaduva (Bhuj Dist.); Gujarat: Vaghjipur (Mehsana).

Measurements:	W	B	Tar.	T
2 ♂♂	468–475	42–49	103–104	246–256
2 ♀♀	490–498	47–49	106–110	254–270

Colours of soft parts of GS319: Iris damaged; bill plumbeous, black at tip; cere and feet greenish lemon yellow; claws horny black.

In the pale brown plumage, distinguishable in flight from *Aquila rapax* (in comparable colour phase) by its slenderer build, narrower wings and proportionately longer and square-ended (against rounded) tail. One was observed devouring a paddy bird (*Ardeola grayii*) on the ground. Another was busy tearing up and demolishing a pariah kite nestling calmly and composedly with the frantic parents innocuously stooping at it again and again! The stomach of a specimen contained fur, apparently a hare's.

Breeding was in progress in December, but presumably commences a month or so earlier. In October a pair were observed carrying large sticks and tangles of twigs in their feet to a massive old nest of sticks on the topmost ramparts of Bhujia Fort (Kutch).

Kirke Swann ('A Monograph of the Birds of Prey', Part xi: 73) recognises a large Indian breeding race, *H. f. grandis* (Hodgson), giving its wing measurements as '♂ 465–495; ♀ 505–530'. Besides being larger it is said to average a little darker; more buffish less pure white below; abdomen more heavily marked; thighs a more uniform brown, striped with blackish and a little mottled with white. No. GS319 conforms with this description, and should the race be resuscitated this specimen must be considered as belonging to it. It had a mature ovary (largest follicles over 2 mm.) and was apparently ready to breed.

Hieraëts pennatus (Gmelin). The Booted Eagle.

Specimens collected: Gujarat: GS736 ♀ 27-12-45 Patan (Mehsana Dist.); GS754 ♀ 30-12-45, GS771 ♀ 31-12-45 Radhanpur.

Elsewhere noted: Gujarat: Cambay town environs; Deesa (Palanpur).

A specimen was collected in Kutch by the Maharao in 1896 and two more by Sir Geoffrey Archer in 1939/40.

Measurements:	W	B	Tar.	T
3 ♀♀	385–423	34–36	65–69	204–225

I do not know how far, if at all, the race *milvoides* of Jerdon is tenable. Kirke Swann (op. cit., Part xi: 79) says it is 'larger than *H. p. pennatus*. Wing ♂ 375–405; ♀ 425–530; the head with a rudimentary crest . . .'

These Gujarat specimens possess no rudimentary crest and their measurements agree with the typical race which, however, Kirke Swann does not give as a winter visitor to India at all! Hartert (Vög. pal. Fauna, ii: 1113) mentions Indian collected specimens as being larger, but he does not consider the naming of an Indian race worth while. With this Ripley and I agree.

This eagle also has dark and pale plumage phases. In the dark umber brown phase it resembles the immature Brahminy Kite (*Haliastur indus*) on the wing, but has a proportionately longer and square-ended tail, against rounded in the Brahminy.

A number of Booted Eagles collected to roost every evening (December) in the large leafy tamarind, casuarina and other trees in the rambling old neglected compounds of Lalbagh and Jorawar Bagh palaces, and the species was fairly common in the Radhanpur area.

On 12 January a stick nest like a crow's near the top of a *Prosopis* tree in semidesert country (Deesa) presumably held young. One of the parent eagles was bringing food to the nest. A shikra was observed haunting the tangle of branches below the nest, and to work his way up to it each time the owner left, and help himself to the food. He promptly slipped down into the thorny tangle upon return of the owner, and remained there quietly till the nest was again left unattended ! When shot on the nest in this act of pilfering, blobs of freshly extracted brain were found adhering to his bill. It could not be ascertained whether this was the brain of a nestling eagle which he had murdered, or belonged to some quarry which the parent had brought to the nest. But for a certain element of doubt, this would be the first authentic recent record of *H. pennatus* breeding in peninsular India. Unfortunately I was unable to satisfy myself that this nest actually did contain young at the time. And in view of the habit of many birds of prey to use old nests—usually their own, it is true—as larders or feeding tables even in the non-breeding season, the evidence is rather vitiated. I failed to secure the specimen of the eagle. Gonad examination could possibly have settled the doubt.

Aquila heliaca heliaca Savigny. The Imperial Eagle.

Specimens collected: Kutch: KS430 ♀ 27-2-1946 Pung Bet (Little Rann); Gujarat: GS505 ♀ 8-12-45 Pariej (Kaira Dist.)

Elsewhere not definitely identified, but several of the large eagles sparsely dotted about on the bare ground in the Little Rann of Kutch, where KS430 was secured, were probably this species.

Measurements :	W	B	Tar.	T
2 ♀♀	630–632	60–66	102–105	284–328

Iris yellowish brown; cere and gape yellow; bill plumbeous, blackish at tip; legs and feet chrome yellow; eyeshade and eyelid yellow.

The stomach of GS505 contained a recently swallowed Russell's Viper (*Vipera russelli*), 14 inches long, and remains of a Common Sandpiper (*Actitis hypoleucos*); that of GS430 had the remains of two large Fat-tailed Lizards (*Uromastix*).

Aquila rapax vindhiana Franklin. The Indian Tawny Eagle.

Specimens collected: Saurashtra: GS1013 ♂+ 16-3-1946 Dalkhania (Amreli Dist.); Gujarat: GS318 ♀+ 20-11-45 GS374 ♀+ 23-11-45 Dabka (Baroda Dist.); GS378 ♀+ 27-11-45 Cambay town environs; GS588 ♀ 15-12-45 Vaghjipur (Mehsana Dist.); GS821 ♀+ 4-1-46, GS842 ♂ 6-1-46 Radhanpur; GS1130 ♀ juv. 29-3-46, GS1189 ♂ 3-4-46 Dediapada (Rajpipla); SD131 ♀ 2-3-48 Galkund (Surat Dangs).

Measurements :	W	B	Tar.	T
2 ♂♂	500–503	50–51	80–87	251–252
6 ♀♀	510–528	48–55	84–91	242–264

Colours of soft parts : *Adult*: iris yellow brown; cere and gape lemon yellow; bill horny black, plumbeous at base of lower mandible; feet yellow, claws horny black. In specimen GS588 (in very pale buff plumage) cere ivory white.

The above series contains almost every colour phase from dark umber brown (almost black) to pale cream or buff. This wide range of colour variation makes the Tawny Eagle a difficult bird to identify with certainty in the field, particularly in winter when several other migratory eagles are also present. Perhaps even more so in the museum when jumbled up with skins of the other eagles of varying ages, e.g. *Aquila nipalensis*, and when the measurements overlap. I can see no overwhelming reason for not considering *rapax* and *nipalensis* as conspecific.

A common resident species over the entire area. Breeding was in progress between November and March. The crop of one specimen contained fresh and not very mangled remains of a Grey Quail (*Coturnix*) and a Bush-Quail (*Perdicula*).

Aquila nipalensis nipalensis Hodgson. The Eastern Steppe Eagle.

Specimen collected: Kutch: KS431 ♂ 27-2-1946 Pung Bet (Little Rann).

Elsewhere not definitely identified, but some of the large eagles perched on the bare ground along the edge of the 'bet' (island) where this one was shot, were apparently this species.

Measurements:	W	B	Tar.	T
1 ♂	570	55	93	288

In worn plumage and moulting primaries. Iris grey-brown; cere and gape pale yellow; bill horny plumbeous, black at tip; feet yellow; claws black. Stomach empty at 11 a.m.

The specimen is in immature plumage, streaked on the breast. Head pale golden brown with a buff patch on nape. On the whole similar to the phase described for 'young birds' under *A. heliaca* in (F.B.I., v: 69).

Aquila clanga Pallas. The Greater Spotted Eagle.

Specimens collected: Gujarat: GS506 ♀ 8-12-45 Pariej (Kaira Dist.); GS937 ♂+, GS938 ♀+ 19-1-46 Hathidhara (Palanpur).

Elsewhere not identified with certainty.

Measurements:	W	B	Tar.	T
1 ♂	485	47	85	242
2 ♀♀	533–545	52–55	90–105	260–272

Usually seen in the neighbourhood of jheels. At 5-30 p.m., at the end of what one would imagine to be the foraging day, the stomach of GS506 was quite empty. Of the other two, one contained an entire chamaeleon with a *Calotes* lizard, and the other, remains of a Whitebreasted Kingfisher (*Halcyon smyrnensis*) including the complete head and bill.

GS937 and GS938 were a pair. Testes of male 17 × 7 mm.; largest ovarian follicle of female over 3 mm. diameter. The birds were either breeding or quite ready to breed, and if their identification is correct this will be the first authentic presumptive evidence of *A. clanga* breeding within Indian peninsular limits.

Ictinaëtus malayensis [perniger (Hodgs.)]. The Black Eagle.

Definitely observed only once — a single bird beating over teak and mixed deciduous forest at Jambughoda (Gujarat), 11-11-1945.

Haliaëtus leucogaster (Gmelin). The Whitebellied Sea Eagle.

Not met with by the Surveys nor recorded from the area by Butler or Hume. Mr. Harinarayan Acharya of Ahmedabad gives an accurate description of a bird he saw on Gobhlaj lake, 18 miles south of Ahmedabad on 9-2-1936 which was presumably this species. This freshwater lake is about 50 miles from the nearest sea coast to which this eagle is normally restricted. An unusual record.

Haliaëtus leucoryphus (Pallas). Pallas's Fishing Eagle.

Occasional solos were observed on the Mahi River at Golana (Cambay), and on the Banas River (Palanpur). According to Butler, occurs sparingly throughout the plains in the well watered districts of northern Gujarat, to which Hume adds Kutch and Saurashtra as well.

Ichthyophaga ichthyaëtus [ichthyaëtus (Horsfield)]. The Greyheaded Fishing Eagle.

Noted only at Balaram (Palanpur), a pair on a perennial rocky forest stream with shingly bed and rock pools. Perches upright and motionless on boughs of riverbank trees. In flight the comparatively short white tail and white abdomen and vent are conspicuous. Call: a single screaming note, not particularly loud, of the timbre of the Grey Hornbill's (*Tockus birostris*) ' laugh '.

Sarcogyps calvus (Scopoli). The Black or King Vulture.

Observed in small numbers throughout the area. On 10 March (1944) a nest with c/1 was found on the ' roof ' of a kandi tree (*Prosopis spicigera*), about 12 ft. up, growing amongst sand-dunes near Mandvi (Kutch). A pair of Whitethroated Munias (*Uroloncha malabarica*) were constantly entering and leaving the pile of sticks right under the brooding owner, and evidently had their nest within. Nesting was in progress in Kutch generally during March.

It will bear reiteration that this vulture's reputation for boldness and pugnacity is entirely fictitious. If a ' King ', it is certainly a very timid and constitutional one!

Aegypius monachus (Linnaeus). The Cinereous Vulture.

A rare straggler. An example was picked up dead by Mr. Harinarayan Acharya near Ahmedabad on 25-12-1949 (*JBNHS*, 49 : 307). He measured it as Wing 770 ; Tail 390 mm. The only other record for Gujarat is of one seen feeding on the carcase of a Painted Stork (*Ibis leucocephalus*) by Capt. A. E. Butler in the winter of 1870 (*S.F.*, iii : 441).

Four birds were observed by me on the ground in the Little Rann of Kutch near Sandher in Radhanpur territory, on 3-1-1946.

Gyps fulvus ssp, The Fulvous Vulture.

A few examples of this vulture, distinguishable from others by its enormous size and distinctly reddish-fulvous or cinnamon coloration, were observed at various times during the Kutch survey, August 1943 to

March 1944. In Gujarat it was only noted in the neighbourhood of Deesa (Palanpur). The commoner *Gyps indicus* has often been mistaken by observers for this species.

Gyps indicus ssp. The Longbilled Vulture.

Noted: Kutch: Mandvi. Gujarat: Ajwa and Dabka (Baroda Dist.); Cambay town environs; Vaghjipur (Mehsana Dist.); Deesa (Palanpur); Songadh (Navsari Dist.) In smaller numbers than the Whitebacked Vulture at animal carcases. Possibly nests on the cliffs about Salher Fort.

Gyps bengalensis (Gmelin). The Whitebacked Vulture.

The commonest vulture in the whole area. Birds on nests were seen in numbers, and generally, between December and February. Large tamarind, mango and *Ficus* trees are usually selected on the outskirts of towns and villages. Flying young were first noted on 31 March (Dediapada, Rajpipla).

Neophron percnopterus ssp. The White Scavenger Vulture.

Fairly common over the whole area. Nesting in Kutch during August. Turrets and ledges in crumbling old forts and buildings, niches and hollows in weathered sandstone scarps are favourite sites for the filthy nests, and the droppings of the birds whitewashing the surroundings give them away from afar.

Circus macrourus (S. G. Gmelin). The Pale Harrier.

Specimens collected: Kutch: KS195 ♀ 9-9-1943 Ratnal (between Bhuj & Kandla); Gujarat: GS151 ♂ 7-11-45 Bodeli (Baroda Dist.); GS440 ♂ 30-11-45 Cambay town environs; GS519 ♂, GS520 ♀, GS521 ♀ 9-12-45 Nadiad town environs (Kaira Dist.); GS828 ♀ 4-1-46 Radhanpur; GS1108 ♂ + 26-3-46 Rajpipla town environs; SD201 ♀ 6-3-48 Pandwa (Surat Dangs).

Measurements:	W	B	Tar.	T
4 ♂♂	347–355	25–27	69–70	207–222
5 ♀♀	350–376	27·5–31	(67) 72–78	222–240

Fairly common winter visitor. Earliest seen 24 August (Mandvi, Kutch); latest 29 March (Rajpipla). According to Butler (*S.F.*, iii : 447) arrives in northern Gujarat (Deesa) about 2 August. Solos, in graceful flight, skimming the tops of standing crops, or scrub and bushes, in open country. Gonads of a specimen on 26 March showed a slight development; an individual flying purposefully, with steady wing beats, about 400 ft., up in a due N. direction on 29 March (7-30 a.m.) was evidently emigrating.

Circus pygargus (Linnaeus). Montagu's Harrier.

No specimens collected, and not definitely identified in the field, but it must doubtless often be confused with *C. macrourus* on account of their great superficial similarity. Lester ('Birds of Cutch', 2nd. ed.) considered it equally common with the Pale Harrier in Kutch during the winter months. In the hand the surest way to distinguish the two species seems to be the shorter tarsus of *C. pygargus,* normally *under* 65 mm.

Circus aeruginosus aeruginosus (Linnaeus). The Marsh Harrier.

Specimen collected : Gujarat: GS1041 ♀ 19-3-1946 Kharaghoda.

Elsewhere noted: Kutch: Kandla; Mandvi. Saurashtra: Mithapur (Okhamandal). Gujarat: Ajwa (Baroda Dist.); Golana (Cambay); Vaghjipur (Mehsana Dist.); Balaram (Palanpur); Laochali (Surat Dangs).

Measurements :	W	B	Tar.	T
1 ♀	413	36	96	227

Winter visitor. Fairly common, singly, at jheels and marshes. Butler (*S.F.*, iii: 448) saw 'young' birds in the dark blackish brown plumage, with buffy white heads (female plumage), as early as the beginning of July in the neighbourhood of Deesa, Hume comments on this '. . . a few pairs certainly remain to breed in Southern, Central and Northern India.' There is no authentic record of the Marsh Harrier ever having bred within Indian limits.

Circaëtus gallicus gallicus (Gmelin). The Short-toed Eagle.

Specimens collected : Gujarat: GS150 ♂ 7-11-45 Bodeli (Baroda Dist.); GS369 ♂+ 22-11-45 Dabka (Baroda Dist.); GS683 ♀ 21-12-45 Vaghjipur (Mehsana Dist.); GS807 ♀ 2-1-46 Radhanpur; GS900 ♀+13-1-46 Deesa (Palanpur).

Elsewhere noted : Kutch: Nakhatrana, Khari Rohar, Nir (Pachham Island). Mandvi. Saurashtra: Okha. Gujarat: Champaner; Golana, Cambay; Nadiad (Kaira Dist.) Kharaghoda; Songadh (Navsari Dist.) etc.

Measurements	W	B	Tar.	T
2 ♂♂	520–525	45–46	93–98	277–283
2 ♀♀	538–550	47–48	94–96	287–288

Fairly common in dry sand-dune and open country with cultivation and sparse scrub, and dotted with babul trees. Keeps a look-out from the tops of trees, and also hovers cumbrously 40 or 50 ft. up in the air to espy snakes and lizards which form a considerable proportion of its diet. One bird when flying over and hit by shot, suddenly jinked and disgorged a snake, about 12″ long, in mid air but instead of jettisoning it, promptly transferred it to its talons and flew on complacently with the reptile dangling below ! Another, after hovering stationary at 1300 to 1500 ft. above the plain (i.e. about 300 ft. above the summit of Songadh Fort) pulled in its wings and dived at an almost vertical angle (*ca.* 70°) on to the fallow cultivation right at the base of the hill to seize some quarry, bespeaking phenomenal keenness of sight.

Breeding was in progress between November and February. During this period pairs are often seen flying in circles high up in the air uttering a kite-like *pieeou*, *pieeou*, etc.

Spilornis cheela minor (Hume). The Crested Serpent Eagle.

Specimens collected: Gujarat: GS945 ♀ 20-I-46 Balaram (Palanpur); GS1154 ♀ 30-3-46 Dediapada (Rajpipla); GS1088 ♀+ 25-3-46 Juna Rajpipla.

Elsewhere noted: Gujarat: Mahal and Laochali (Surat Dangs).

Saurashtra: Dalkhania (Amreli Dist.); Bhavnagar (specimen: Dharmakumarsinhji). Absent in Kutch.

Measurements:	W	B	Tar.	T
3 ♀♀	469–481	43–48	99–109	290–315

All the above are with unbarred breast and grey tail band diagnostic of this race. A male received from K. S. Dharmakumarsinhji (Bhavnagar, 26-11-1947) in worn plumage has a wing of 440 + mm. (tips worn). It has the barred breast and black chin and throat of typical *S. c. cheela.* This may either be a migrant from N. India or an aberrant throwback to the typical race as suggested by Whistler (Mysore Survey, *JBNHS*, 44: 21).

Not uncommon is deciduous forest country where its presence is advertised by the characteristic prolonged screaming call *kee-kee-kee* as pairs soar high up in the heavens. This call is usually prefaced by three short notes like *pu-pu-pu* quickly upeated in undertones and audible only at short range. Breeding was in progress in March.

Pandion haliaëtus haliaëtus (Linn.). The Osprey.

Specimen collected: Gujarat: GS822 ♀ 4-1-46 Radhanpur.

Elsewhere noted: Kutch: Mandvi. Saurashtra: Dwarka; Viramgam. Gujarat: Ajwa (Baroda Dist.); Golana, Cambay; Vaghjipur (Mehsana Dist.).

Measurements:	W	B	Tar.	T
1 ♀	537	43	61	251

Winter visitor, not abundant but usually one or two present on most of the larger rivers and jheels. One was observed to plunge headlong after a fish from about 40 feet up where it was hovering in the air, with a great splash, becoming completely submerged. It wrestled for several seconds with the quarry, bobbing up and down in the water as if struggling to keep afloat. Finally it rose clear, flying heavily with the weight of the large fish which it successfully managed to drag along the surface and land on the bank.

Family FALCONIDAE: Falcons.

Falco jugger J. E. Gray. The Laggar Falcon.

Specimens collected: Kutch: KS253 ♂+ 20-9-43 Rapar; KS421 ♀ juv. 29-3-44 Bela Island (Great Rann). Gujarat: GS261 ♂ 17-11-45, GS333 ♀ 20-11-45 Dabka (Baroda Dist.); GS788 ♂ 1-1-1946 Radhanpur; GS859 ♂, GS860 ♂ 10-1-46, GS903 ♂+ 13-1-46 Deesa environs (Palanpur). Saurashtra: GS1026 ♀+ 16-3-46 Dalkhania (Amreli Dist.).

Elsewhere noted: Kutch: Mata-no-Madh; Chobari (Bhachau Dist.); Dholovira (Khadir Island); Bhuj; Khavda Pachham Island. Saurashtra. Dwarka.

Measurements:	W	B	Tar.	T
6 ♂♂	316–335	25–31	49–53	165–183
2 ♀♀	357–360	27–31	46–54	186–210

Resident. Fairly common. Breeding in March, but a male collected in Kutch on September also had moderately developed testes. KS421 is a juvenile which left the nest with wobbly unsteady flight when it was climbed up to. Its two other nest-companions were more advanced in development and just managed to flutter away. Its soft parts were noted as follows: Iris brown; bill bluish grey, brownish near tips of both mandibles; legs and feet pale grey; claws horny black. The nest, a large stick platform with a deep centre, was 30 ft. up in a peepal tree on the outskirts of a village. Stomachs of adults contained feathers and remains of birds (including, in one case, two entire legs of *Argya caudata*), skin and fur of some rodent, and grasshoppers. A laggar regularly frequented one of our camps and carried off the carcases of skinned birds thrown outside.

Falco peregrinus ssp. The Peregrine Falcon.

No specimens collected. Observed: Kutch: Nakhatrana (2 Sept.); Rapar (19 Sept.); Pung Bet (Little Rann, 1 March). Gujarat: Kharaghoda (19 March). Solos observed by Dr. H. C. Aldrich at Nadiad, Kaira Dist., in December 1944 and November 1945. Stoliczka shot one in Kutch and Hume obtained it at Dwarka, Saurashtra (*S.F.*, iii: 443—1875). Winter visitor. Not common, and occasional.

Falco peregrinoides babylonicus Sclater. The Redcapped Falcon.

Specimens collected: GS818 ♂ 3-1-46 Radhanpur; GS874 ♀ 11-1-46 Deesa (Palanpur).

Elsewhere not noted. Recorded from Kutch by Lester and more recently by Sir Geoffrey Archer (specimen).

Measurements:	W	B	Tar.	T
1 ♂	276	27.5	45	122
1 ♀	281	27.5	39	133

Winter visitor. Met with in semi-desert country with sand mounds *Capparis* bushes and scattered trees of *Prosopis spicigera* etc. One stomach contained a leg and other remains of *Passer* (? *domesticus*).

Falco subbuteo ssp. The Hobby.

No specimens obtained. Single birds were observed in Kutch, at Nir (Greaf Rann) and Mandvi, in October and March. One was chasing a tired-out willow warbler just arriving on migration across the open expanse of the Great Rann. By keeping to the stony hillocky country about the base of Kala Dongar (along the northern edge of the Rann) in the autumn migration season, these little falcons doubtless reap a rich harvest of exhausted incoming small birds. Neither Butler nor the Gujarat Survey came across it in the plains of Gujarat.

Falco chicquera chicquera Daudin. The Redheaded Merlin.

Specimens collected. Kutch: KS79 ♀ 18-8-1943 Chaduva (Bhuj Dist.); KS113 ♂ 24-8-43 Mandvi. Gujarat: GS94 ♂ 2-11-1945 Ajwa (Baroda Dist.); GS389 ♂ 27-11-45 Cambay town environs; GS829 ♂ 5-1-46 Radhanpur.

Elsewhere noted: Kutch: Lakhpat; Dholovira; Nir; Padhar.

Measurements:	W	B	Tar.	T
4 ♂♂	200–207	19–24	37–40·5	125–137
1 ♀	230	—	41	156

In the last week of August, KS113 was moulting primaries and rectrices. Fairly common. Frequents semidesert in the neighbourhood of cultivation. Usually seen in pairs hunting in close co-ordination, one bird pursuing and the other heading off the quarry. Stomachs contained remains of small birds. Curiously enough, the stomach of one shot at sunset was completely empty! No data as to breeding were provided by the specimens.

Falco tinnunculus tinnunculus Linn. The Kestrel.

Specimens collected: Suarashtra: B4 ♀ 12-10-43 Dwarka. Gujarat: GS93 ♂ 21-11-45 Ajwa (Baroda Dist,); GS217 ♀ 10-11-45 Jambughoda; GS356 ♂ 21-11-45 Dabka (Baroda Dist.); GS398 ♀ 28-11-45 Cambay town environs; GS486 ♂ 4-12-45 Golana, Cambay; GS650 ♂ 19-12-45 Vaghjipur (Mehsana Dist.); GS721 ♂ Patan (Mehsana Dist.); GS1046 ♂ 20-3-46 Kharaghoda.

Elsewhere noted: Kutch: Bhuj; Anjar; Rapar; Bhachau; Mandvi; Dholovira etc. Saurashtra: Okha; Dhari: Dalkhania; Kodinar etc. Gujarat: Radhanpur; Deesa; Palanpur; Pariej (Kaira Dist., specimen: H. C. Aldrich).

Measurements :	W	B	Tar.	T
6 ♂♂	236·5–253	18·5–22	41–46	155–175
2 ♀♀	243–260	20–22	41–43	158–180

A common winter visitor. Earliest date 30 August (Bhuj); latest 29 March (Adesar, Little Rann.)

Usually solos hovering, or on favourite look-out posts—mounds, telegraph poles, dead trees, etc. One individual came in to roost every night (November) on a rolled-up sun blind in the first floor verandah of the Rest House at Ajwa!

It is not unlikely that the resident race of the kestrel, *F. t. objurgatus*, breeds on the cliffs about Fort Salher (*ca.* 5000 ft.) in Navsari Dist. The western aspect of this hill is a sheer cliff with suitable-looking nesting sites. In March (1948) 2 or 3 pairs (race ?) were observed disporting themselves around this escarpment in a very suggestive manner, shooting high up in the air with the wind, and hovering in a way quite distinct from hunting—rather like the display of *Astur badius* at breeding time.

Family PHASIANIDAE: Junglefowl, Partridges, Quails.

Francolinus francolinus ssp. The Black Partridge.

Specimens collected. Kutch: KS101 ♂+ 21-8-1943 Chaduva (Bhuj Dist.); KS371 ♂+ 15-3-44 Jakhau.

Elsewhere noted: Kutch: Mandvi; Bhuj environs; Mata-no-Madh.

Measurements:	W	B	Tar.	T
2 ♂♂	156–163	23·5–25	46	89–92

These specimens approximate to the pale Sind-Baluchistan-Iran race *henrici*, but it must be pointed out that black partridges have been introduced into Kutch from time to time to augment the game bird stock without particular regard to their place of origin; therefore a certain amount of racial confusion is inevitable. Pure white albinos have been reported.

Affects sandy grass-covered dunes in the vicinity of irrigation tanks, riparian tamarisk jungle, and afforestation plots. Breeds in Kutch during August.

According to Hume, Deesa whence Butler recorded a specimen, is about the line of junction of the Black Partridge and the Painted which is the common species of Gujarat and the Deccan (*S.F.*, iv : 6).

Francolinus pictus ssp. The Painted Partridge.

Specimens collected: Saurashtra: GS994 ♂ 15-3-1946 Dalkhania (Amreli Dist.); Gujarat: GS1190 ♀, GS1191 ♂, GS1192 ♀ 3-4-46 Dediapada (Rajpipla); GS1306 ♀ 20-4-46 Galkund (Surat Dangs); SD184 ♂+ 6-3-48 Pandwa (Surat Dangs).

Elsewhere noted: Gujarat: Ajwa (Baroda Dist.); Dakor (Kaira Dist., specimens H. C. Aldrich !); Gangasagar (Palanpur); Dohad (specimens A. E. Jones!); Ratlam (specimen V. S. LaPersonne!). Absent in Kutch.

Measurements:	W	B	Tar.	T
5 ♂♂	140–149	23–26	37–45	65–68
5 ♀♀	140–151	21–24	41–46	64–69

I can see no difference between the above specimens and the one collected in Central India on which Mr. Whistler was unable to satisfy himself of the existence of two races in India. If anything, some of the central Indian birds are *darker* than this series and not paler as they should be (F.B.I., v : 414). According to Stuart Baker, however, Gujarat specimens in the British Museum from Gondal, Deesa, Ahmedabad, Abu and Neemuch are *pallidus* !

Small numbers in grassland along streams, in fallow and stubble fields overgrown with weeds, and in the vicinity of abandoned forest cultivation overgrown with grass and scrub. The testes of SD184 (6 March) showed a slight enlargement but no other evidence of the breeding season in Gujarat was obtained. According to Butler (*S.F.*, iv : 6) it breeds in northern Gujarat from end July to end September. I was able to get some support for the assertion of a local shikari in Central India that the female also calls like the male (*JBNHS*, 41 : 482), but conclusive evidence remains to come.

Francolinus pondicerianus interpositus Hartert. The Grey Partridge.

Specimens collected: Kutch: KS238 ♂+, KS239 ♂+ 17-9-1943 Bhachau. Saurashtra: GS993 ♀ 15-3-46 Dalkhania (Amreli Dist.). Gujarat: GS18 ♀+, GS19 ♂+ 29-10-45 Dabka (Baroda Dist.); GS451 ♂ 2-12-45 Golana (Cambay); GS576 ♂+ 15-12-45, GS610 ♂ 17-12-45, GS642 ♀ 18-12-45, GS648 ♂ 19-12-45, GS687 ♀+, GS688 ♂+ Vaghjipur (Mehsana Dist.). Also 2 specimens from Kaira Dist. (H. C. Aldrich!) and 1 from Wankaner (Saurashtra—C. M. Crump !).

Measurements:	W	B	Tar.	T
10 ♂♂	144–160	23·5–29	36·5–45	80–94
6 ♀♀	134–145	23–26	37–46·5	79–91

The Gujarat birds are in reality an intermediate population and merely a section of a cline. Therefore individual specimens are impossible to place satisfactorily as to subspecies.

A common and abundant game bird over the entire area, affecting dry open thorn scrub-and-bush country in the neighbourhood of cultivation and villages. Breeds practically throughout the year, but the chief period is evidently from March till November.

Coturnix coturnix coturnix (Linn.). The Common or Grey Quail.

Specimens collected: Kutch: KS156 ♂+ 4-9-1943 Nakhatrana; KS219 ♀ 14-9-43 Tuna (Anjar Dist.). Saurashtra: B40 ♂ 20-10-43 Dhari (Amreli Dist.). Gujarat: GS11 ♀ 28-10-45 Ajwa (Baroda Dist.); GS443 ♀ 30-11-45 Cambay town environs; GS475 ♂ 3-12-45 Golana (Cambay); GS927 ♀ 16-1-46 Palanpur; GS1193 ♀ 3-4-46 Dediapada (Rajpipla); SD181 ♀, SD183 ♀ 6-3-48 Pandwa (Surat Dangs).

Measurements:	W	B	Tar.	T
3 ♂♂	110–115	13·5–16	26–27	31–38
8 ♀♀	112–116	14–16	26–30	33·5–44

A common winter visitor to the entire area. Earliest date 4 September (Kutch); latest 3 April (Rajpipla). Affects standing crops of bajri and jowar, cotton fields and grassland. The specimen of 3 April was very fat, suggesting that it was ready to emigrate.

In Butler's time about 1875, it used to be so abundant in winter about Deesa and Ahmedabad that '2 guns, or even one good gun, might without difficulty shoot 100 brace in the day' (*S.F.*, iv : 6).

Coturnix coromandelica (Gmelin). The Blackbreasted or Rain Quail.

Specimens collected: Gujarat: GS476 ♂ 3-12-45 Golana (Cambay); GS569 ♂, GS570 ♀ 12-12-45 Saiat (Kaira Dist.); GS940 ♀ 19-1-46 Hathidhara (Palanpur). Saurashtra: GS964 ♂ 11-3-46 Kodinar.

Measurements:	W	B	Tar.	T
3 ♂♂	93–95	12·5–13	23–26	29–32
2 ♀♀	96–97	12–14	26–26·5	29·5–31

Evidently resident, but certainly has its numbers largely augmented during the winter months by influx from adjoining areas. Unfortunately little is definitely known about its seasonal movements. The gonads of the specimens furnished no indication as to breeding; according to Butler (*S.F.*, iv : 7) it breeds in northern Gujarat in August and September.

Perdicula asiatica asiatica (Latham). The Jungle Bush-Quail.

Specimens collected; Gujarat: GS1194 ♀ 3-4-46 Dediapada (Rajpipla); SD161 ♀ 5-3-48, SD185 6-3-48 Pandwa; SD217 ♂, imm. SD218 ♂ imm., SD219 ♂ + 7-3-48 Babulnaghat; SD275 ♀, SD276 ♀ imm 12-3-48 Laochali (SD = Surat Dangs).

Measurements:	W	B	Tar.	T
4 ♂♂	81–88	15–17	25–30	34–37
3 ♀♀	80–88	15·5–16	26–31	36·5–40

Perdicula argoondah ssp. The Rock Bush-Quail.

Specimens collected: Kutch: KS64 ♂+ 16-8-43 Chaduva (Bhuj Dist.); KS378 ♂, KS379 ♀ 17-3-44 Mata-no-Madh. Gujarat: GS254 ♂+, GS255 ♀+ 17-11-45; GS366 ♀+ 22-11-45 Dabka (Baroda Dist.); GS789 ♂ 1-1-46 Radhanpur; GS887 ♂, GS888 ♂ 11-1-46, GS907 ♀, GS908 ♂, GS909 ♀, GS910 ♂, GS911 ♂, GS912 ♀ 13-1-46 Deesa environs (Palanpur). Saurashtra: GS992 ♂ + 15-3-46 Dalkhania (Amreli Dist.).

Measurements :	W	B	Tar.	T
10 ♂♂	82-88·5	13–16	25–27	43·5–46·5
6 ♀♀	82–86	14–15·5	24–25	40–47

The three specimens from Dabka (Baroda Dist.), three from Kutch and one from Saurashtra are somewhat darker and less sandy than the rest of the series and seem nearer the typical race, though actually intermediate between it and the pale Rajputana *meinertzhageni*. The series from Deesa, and the Radhanpur bird are *meinertzhageni*, matching specimens so attributed by Whistler from Badarwas (in northwest Gwalior) and Jodhpur.

I do not understand the significance of the fact that the juvenile plumage of some females has the underparts barred on the breast and flanks with blackish brown as in the adult male ! In addition to this, one female (GS912) possesses the dull brick red chin and throat-patch of the male.

The normal condition in birds is for the juvenile male to resemble the adult female in plumage, and not vice versa as in these cases. The sexing was checked by me personally.

Both Bush-Quails are common throughout Kutch, Saurashtra and Gujarat in the appropriate scrub and bush facies. The Rock Bush-Quail is found in the stonier and drier parts, the Jungle Bush-Quail preferring rather more densely scrubbed country and open deciduous forest.

Odd pairs were found breeding from August to March, but the season was more general between October and January when, besides the evidence of the gonads, chicks in all stages were met with from freshly hatched to pullet and sub-adult.

Galloperdix spadicea spadicea (Gmelin). The Red Spurfowl.

Specimens collected : Gujarat, GS941 ♀ + 19-1-46, GS955 ♂, GS956 ♂, GS957 ♂, GS958 ♂, GS959 ♀ 20-1-46 Hathidhara (Palanpur) ; GS1153 ♂ + 30-3-46 Dediapada (Rajpipla); GS1233 ♂+ 9-4-46 Songadh (Navsari Dist.); GS1259 ♀+ 13-4-46 Waghai (Surat Dangs); SD141 ♀ + 3-3-48 Galkund; SD202 ♂+ 7-3-48 Pandwa (Surat Dangs). Absent in Kutch though some parts, e.g. Chaduva and Mata-no-Madh, seem eminently suited to it ecologically.

Measurements :	W	B	Tar.	T
7 ♂♂	160–165	25–26	44–52	124–143
4 ♀♀	153-160	22·5–26	43–46	120–125

Common in bamboo and mixed deciduous forest in stony foothills country broken by nullahs. Breeding January to April.

Specimens from Waghai, Songadh, Dediapada and Hathidhara are progressively paler and tending towards the pale Aravalli race *caurina*. I have not been able to examine any topotypical material of *caurina*, but Stuart Baker (F.B.I., v : 361) mentions that birds from the Bombay Presidency immediately south of Mount Abu are darker than Abu birds, and though intermediate are nearer to *spadicea* than to *caurina*. Hathidhara is part of the country immediately south of Mount Abu to which these remarks would presumably apply.

Capt. Butler (*S.F.*, iv : 5) says it breeds in N. Gujarat in the hot weather. He often saw chicks with the old birds 'shortly after they have been hatched in May and June.'

Gallus sonnerati Temm. The Grey Junglefowl.

Specimens collected: Gujarat; GS954 ♂ (1st year) 20-1-46 Hathidhara (Palanpur); GS1232 ♀ 9-4-46 Songadh (Navsari Dist.); SD1 ♂ 23-2-48 Malegaon (Surat Dangs).

Elsewhere noted: Gujarat: Champaner and Pavagadh (Panchmahals Dist.); Gangasagar (Palanpur); Dediapada (Rajpipla); Mr. R. M. Simmons noted it, at Khedbrama and Saranga Hill, Mehsana Dist. in the Ahmedabad neighbourhood, and has shot it at Vijainagar (*ca.* 1932), Absent in Kutch.

Measurements:	W	B	Tar.	T
1 ♂ ad.	247	21 (from base of comb)	77	372
1 ♀ ad.	201	32	64	138

Not uncommon locally in hilly bamboo, teak and mixed deciduous forest. Very fond of the ripe windfallen figs of *Ficus bengalensis* and *F. glomerata*, coming out to feed under the trees where local shikaris usually ambush them. The crow of the cock seemed sensibly different from that of south Indian birds.

Its persecution by shikaris, commented on by Capt. Butler in 1876, still continues, and it is a wonder that this species has held out despite this.

Pavo cristatus Linn. The Peafowl.

Specimen collected: Gujarat: GS1309 ♀ pull. 21-4-46 Galkund (Surat Dangs).

Common throughout the area, largely in a semi-feral state. Near villages, where unmolested, it boldly enters cultivation and does considerable damage to newly sown groundnuts and cereals with impunity. But it is difficult to conceive of a warier and more circumspect creature than a forest-living peafowl, especially where subjected to persecution by humans.

Breeding was in progress during August (Kutch). When displaying to a hen—train fanned out, erect and slightly tilted forward—the cock keeps his legs partly flexed while facing her and prances from one foot to the other in mincing steps as if stalking her—very reminiscent of the holding manoeuvre in the Indian game of 'Āta pāta'. One cock was observed to interrupt such a display in order to chase off a rival with a full and resplendent train like his own, but he showed no resentment towards a young cock with short mangy tail displaying assiduously before 2 hens on the fringe of his own coterie, who was obviously cutting no ice with them at all!

Family TURNICIDAE: Button and Bustard-Quails.

Turnix sylvatica dussumier (Temm. & Laugier). The White-legged or Little Button-Quail.

No specimens obtained. Both Lester and Capt. Newnham record it in Kutch from Devisar (Bhuj environs), and the former mentions that a live bird brought to him by a shikari dropped an egg (May 1892). Capt. Butler (*S.F.*, iv: 9) described it as common in the north Gujarat plains. He caught a half grown young in some tall grass near Deesa on 27 July.

Turnix maculatus tanki Blyth. The Yellowlegged Button-Quail.

Specimens collected: Kutch: KS87 ♀+ 18-8-43, KS102 ♀+ 21-8-43, KS103 ♀+ Chaduva (Bhuj Dist.); Gujarat: GS689 ♀ 21-12-45 Vaghjipur (Mehsana Dist.).
Elsewhere noted: Gujarat. Dabka (Baroda Dist.).

Measurements:	W	B	Tar.	T
4 ♀♀	87–93	14–15	25·5–28	28–34

Iris white; legs and feet bright chrome yellow (colour of 'Koh-i-noor' pencil); bill same, horny at tip.

Frequent, singly and pairs, in grass and scrub country around the grassy edge of tanks, and also in drier facies. Sometimes associates with *T. s. taigoor*, and specimens of both were once collected with the same shot! Breeding was in full swing in August (Kutch).

Capt. Butler found a nest with c/4 near Deesa on 15-7-1875 (*S.F.*, iv: 8).

Turnix suscitator taigoor (Sykes). The Bluelegged or Common Bustard-Quail.

Specimens collected: Kutch: KS147 ♀+ 2-9-1943 Nakhatrana. Gujarat: GS301 ♂ 19-11-1945 Dabka (Baroda Dist.); GS387 ♂, GS388 ♀ 27-11-45 Cambay town environs; GS673 ♀ 20-12-45 Vaghjipur (Mehsana Dist.); GS739 ♀ imm. 27-12-45 Patan (Mehsana Dist.)
Elsewhere noted: Kutch: Bhuj environs; Rapar. Gujarat: Ajwa (Baroda Dist.).

Measurements:	W	B	Tar.	T
2 ♂♂	83–85	15	22–23	35–37
4 ♀♀	89–90	15·5–17	24·5–25	33–41

Specimen GS739 whose sexing as female was confirmed by me personally, and also by its measurements (W 89 mm), is immature. Contrary to the normal condition in birds where the young of both sexes resemble the adult female in plumage, this young female is like the *male*. If this is not an individual aberration, it would appear that the reversal is in keeping with the fact that in this polyandrous species the roles of the sexes are also reversed, the adult female being the dominant partner and more richly coloured (with black chin, throat and breast) than the male.

Fairly common over the entire area. Usually in pairs, inhabiting scrub country bordering cultivation. Breeding August/September, when also the characteristic drumming of the female was commonly heard. In northern Gujarat, Capt. Butler found a nest with 4 fresh eggs at Deesa on 9 August 1875 (*S.F.*, iv: 7).

Family GRUIDAE: Cranes

Grus grus lilfordi Sharpe. The Eastern Common Crane.

No specimens collected. A fairly common winter visitor and passage migrant though in smaller numbers than the Demoiselle, with which it is often associated. Earliest date 13 September (Khari Rohar, Kutch).

Grus antigone antigone (Linn.). The Indian Sarus Crane.

No specimens collected. Not common in Kutch, but plentiful in the cultivated plains of Gujarat where it enjoys protection on sentimental grounds from the human population and is, in consequence, comparatively tame. Breeding August to October. Pairs accompanied by young in December—usually 1, sometimes 2. When one bird of a pair calls, its mate invariably joins in immediately, taking up the 'screams' or trumpeting in a sort of duet. Later on in winter small flocks collect. The largest seen by me consisted of 18 birds.

Anthropoides virgo (Linn.). The Demoiselle Crane.

Specimens shot but not preserved.

An abundant winter visitor and passage migrant over the entire area. Earliest date 13 September (Kandla, Kutch); latest 23 March. Nir, on the northern tep of Pachham Island in the Great Rann of Kutch, is an ideal place for the study of visual migration, and among the numerous species observed there coming through in a NNW.-SSE. direction in the first week of October, perhaps the most spectacular were the flock upon flock of Demoiselle and Common Cranes. On some days flocks of some 30 to 100 birds each passed over in a steady stream at a great height throughout the daylight hours, chiefly between 11 a.m. and 12·30 noon.

The stomachs of two specimens examined were crammed with wheat, and considering the vast swarms which invade the newly sown fields, the damage these cranes do must be considerable.

Family RALLIDAE: Rails, Coots

Rallus striatus [albiventer Swainson]. The Bluebreasted Banded Rail.

No specimens obtained.

Lester and Capt. Newnham both record it from Devisar tank (Bhuj environs) in 1892. I can trace no record for Gujarat, but it must doubtless occur.

Porzana porzana (Linn.). The Spotted Crake.

No specimens obtained.

Lester shot a specimen at Devisar tank (Bhuj environs) Kutch, in the winter of 1892. 'Not very common in N. Gujarat, but tolerably plentiful in swampy country between Ahmedabad and Deesa during winter' (Butler, *S.F.*, v: 215—1877).

Porzana pusilla [pusilla (Pallas)]. The Eastern Baillon's Crake.

No specimens collected. Observed in Gujarat at Ajwa (Baroda Dist.) 28-10-1945, and Balaram (Palanpur) 18-1-46. Solos on weedy marsh at edge of tank. Very tame. Twitching up tail every little while in typical moorhen manner, and also at every step. One bird when alarmed, ran under a dry lotus leaf for refuge and remained hidden there for many minutes, peering out cautiously from time to time to see if the danger was past! Common on tanks between Ahmedabad and Deesa 'in September and later on in the season. Possibly breeding.' (Butler, *S.F.*, v: 215—1877)

Amaurornis akool akool (Sykes). The Brown Crake.

Not met with by the Surveys.

Capt. Butler (*S.F.*, iv, 21) records it as occurring in Northern Gujarat where it frequents 'rocky nullahs, beds of rivers, and marshy grounds. He adds later (v : 224—1877) that it is very common at Milana (18m. SE. of Deesa) where he took many nests during the rains.

Amaurornis phoenicurus spp. The Whitebreasted Waterhen.

No specimens collected. Noted : Gujarat: Ajwa (Baroda Dist.) ; Cambay town environs Nadiad (Kaira Dist.) ; Radhanpur ; Dediapada. (Rajpipla) ; Mahal, Ambika, Waghai etc. (Surat Dangs) and elsewhere. Not common. Hume had specimens from Kutch and 'Kattiawar' (*S.F.*, iv : 21). Capt. Butler found it 'tolerably common' at Milana, near Deesa, and nesting in August (v : 224—1877).

Gallicrex cinerea (Gmelin). The Kora or Watercock.

Not met with by the Surveys. Lester records a pair shot in Kutch by H. H. the Rao Saheb on 4-7-1897. Later he wrote (*JBNHS*, 11 : 321) that he had eggs from Kutch in his collection *presumably* belonging to this species.

Gallinula chloropus [**indica** Blyth.] The Indian Moorhen.

No specimens collected. Noted : Kutch: Chaduva (Bhuj Dist.). Saurashtra: Dhari (Amreli Dist.). Gujarat: Baroda town environs ; Balaram (Palanpur) ; Kharaghoda.

Fairly common. Lester had eggs brought to him from Devisar tank, near Bhuj (Kutch) in July 1893. Butler (*S.F.*, v : 224), in 1876 and thereabouts, found it very plentiful in the tanks at Milana, 18 miles SE. of Deesa, breeding during the rains in the large rush beds.

Porphyrio poliocephalus poliocephalus (Latham). The Purple Moorhen.

No specimens collected. Noted : Kutch: Chaduva (Bhuj. Dist.); Bhimasar tank (Anjar Dist.). Lester found it plentiful and breeding on the Dhonsa jheel in Kutch (season ?). Capt. Butler described it as uncommon in most parts of N. Gujarat, but plentiful on some tanks overgrown with weeds and bulrushes, and Hume adds that it is also common in Kathiawar (*S.F.*, iv : 20).

Fulica atra [**atra** Linn.]. The Coot.

No specimens collected. Noted : Kutch: Bhuj ; Anjar. Gujarat: Cambay town environs ; Dakor (Kaira Dist.) ; Patan (Mehsana Dist.) ; Balaram (Palanpur) ; Kharaghoda.

Mainly winter visitor. Fairly common. Earliest date 12 August (Bhuj); latest 30 March (Anjar). In August 1946 K. S. Dharmakumarsinhji found it breeding in Bhavnagar, Saurashtra—5 nests with eggs—where the species is normally seen only between about September and April. (*JBNHS*, 46 : 724.)

Family Otidae : Bustards

Choriotis nigriceps (Vigors). The Great Indian Bustard.

Noted : Kutch: Rapar (Waghad Dist.) ; Nir (Pachham Island) ; Chobari (Bhachau Dist.).

A female specimen shot by H. H. Maharao Madansinhji on 3-3-1946 was measured by me in the flesh as follows : W 564, B 88, Tar. 162, T 250.

Soft parts : Eyelids (unfeathered) cream colour; bill greyish or ivory white, black at base and tip of upper mandible; legs and feet greyish china white ; claws horny.

Not common in Kutch, but small numbers were to be seen in the sandy, grassy country along the edge of the Great Rann at least till 1946. Its status since then is unknown, though the change in the political set-up is not likely to have improved the position. The rulers of Kutch were particularly mindful about wild life preservation in their State, and infringement of game and netting rules and close seasons, now rampant, was far more liable to be reported and taken serious notice of then than now. A pure white albino has been recorded in Kutch (*JBNHS*, 31 : 526).

K. S. Dharmakumarsinhji knows of a few places in the Bhavnagar area of Saurashtra where this bustard still breeds regularly, or at least bred till a few years ago, and many of us have seen his excellent Kodachrome movie of an adult female and young made there. In northern Gujarat it was apparently 'not at all common' even in the 70's of the last century, but in Kathiawar Hume writes of it then as 'very common' (*S.F.*, iv : 9). Stuart Baker (Game Birds, ii : 172) records a single egg taken in Kutch in January, and Maharao Vijayarajji a newly hatched chick in October (*JBNHS*, 43 : 660).

Chlamydotis undulata macqueeni (J.E. Gray). The Houbara.

1 specimen collected near Khavda (Pachham Island, Kutch) ; 4-10-43. Not preserved. Stomach contained yellow 'phulri' flowers and two species of tenebrionid beetles.

Winter visitor to Kutch ; abundant in some years. In three drives on different days in December 1943 (a good year) among the khip-covered (*Leptadenia spartium*) sand-dunes near Mandvi, H. H. Maharao Madansinhji shot 16 and 17 Houbaras.

Rare in Gujarat, being only occasionally met with during the winter months in the semidesert northern portions, e.g. about Deesa.

Sypheotides indica (J. F. Miller). The Lesser Florican, or Likh

No specimens collected. Common in Kutch, Saurashtra and Gujarat, patchily and in suitable grassy localities, during the SW. monsoon—July to October. Where it disperses at other seasons, and its migratory movements, are not properly known or understood. According to Hume (*S F.*, iv : 10) 'They migrate hither [Gujarat] from the central tablelands of the peninsula, where they spend the cold and dry season.' This seems a vague and unsatisfactory statement considering that the bird is nowhere particularly common or abundant in the Deccan at any season.

The experiment in ringing florican, initiated by K. S. Dharmakumarsinhji in Bhavnagar (*JBNHS*, 44 : 299) was a praiseworthy attempt to elucidate migration data, but the returns so far obtained are not very enlightening. In Mr. Dharmakumarsinhji's opinion the birds cross over from the mainland of peninsular India in a NW. and westerly direction across the Gulf of Cambay to the eastern coast of Kathiawar, commencing in May or June, in advance of the monsoon, and thence spread over Saurashtra, and presumably also Kutch.

It seems tragic that while other game birds enjoy statutory protection during the breeding season, the florican should be subjected to the greatest persecution from 'sportsmen' at this very period owing to the prominence which males give to themselves through their jumping courtship display. The killing of the birds in this season must be rigidly banned if the species is to survive.

Mr. Dharmakumarsinhji has recently made a careful study of the courtship and breeding habits of the florican, and brought to light some interesting and hitherto unrecorded details. (*JBNHS*, 49 : 201-216).

Breeds in Kutch and Saurashtra during the monsoon months when the grass is sufficiently grown to provide cover. Also in standing crops. According to R. M. Simmons, ' breeds in grassy maidans west of Sanad ' (Ahmedabad Dist.), Gujarat.

Family JAÇANIDAE : Jaçana

Hydrophasianus chirurgus (Scopoli). The Pheasant-tailed Jaçana

Specimen collected: Gujarat: GS939 ♀ 19-1-1946 Hathidhara (Palanpur).

Elsewhere noted: Kutch: Bhuj. Gujarat: Ajwa (Baroda Dist.); Pariej (Kaira Dist.), Kanewal jheel (Cambay); Balaram (Palanpur).

Measuremets:	W	B	Tar.	T
1 ♀	240 (to tip of attenuated first primary)	34	58	119

Common on most vegetation-covered tanks etc. Large flocks in winter, sometimes of 50 plus. In off plumage, in flight, the brown head and back, and white wings with black tips are conspicuous. Utters a nasal mewing *tewn*, *tewn* etc.

According to Capt. Butler (*S.F.*, iv: 20) only a cold weather visitant to the country in the Deesa neighbourhood. Humayun Abdulali found it common on Hamirsar tank, Bhuj, in June 1937 (*JBNHS*, 40 : 122).

Metopidius indicus (Latham). The Bronzewinged Jaçana

No specimens collected. Noted at Bhuj (Kutch) also by Humayun Abdulali in June (*JBNHS*, 40 : 122) and several places in Gujarat on vegetation-covered tanks and jheels. Decidedly uncommon.

Family HAEMATOPODIDAE : Oystercatcher

Haematopus ostralegus [ostralegus Linn.]. The Oystercatcher

No specimens collected. Noted : Mandvi (Kutch) in March. Pairs or small loose flocks on the seashore, feeding in company with Dunlins and Sand Plovers. Winter visitor to the sea-coast; apparently not inland.

Family CHARADRIIDAE : Plovers, Lapwings

Chettusia leucura (Licht.). The Whitetailed Lapwing

Specimens collected: Gujarat: GS511 ♂ 8-12-45 Pariej (Kaira Dist.); GS551 ♀ GS552 ♂, GS651 ♀, GS553 ♂, GS554 ♂ 12-12-45 Saiat (Kaira Dist.).

Elsewhere noted: Kutch: Kandla. Gujarat: Kanewal, Cambay.

Measurements:	W	B	Tar.	T
4 ♂♂	179–189	37–38	72·5–75	72–82
1 ♀	186	38	73	77

Winter visitor. Earliest date 5 August (Kandla, Kutch). Parties and flocks on grassy muddy margins of jheels. It is of the same size and general outline as the Yellow-wattled Lapwing, but unlike it always near water.

Chettusia gregaria (Pallas). The Sociable Lapwing

Not met with by the Surveys, although Lester records it as a common cold weather visitor to Kutch. Possibly its visits are as erratic here as they have been noted elsewhere, e.g. Lower Sind. Capt. Butler (*S.F.*, iv : 12), in 1876 and thereabouts, found it ' very common during the cold weather in the neighbourhood of Deesa ' (N. Gujarat), less plentiful further south.

Hoplopterus indicus indicus (Bodd.). The Redwattled Lapwing

Specimens collected: Kutch: No. 47 ♂ 25-5-39 Khari Rohar (Sir G. Archer); Gujarat: GS62 ♀+ 31-10-45 Ajwa (Baroda Dist.); GS190 ♂ 8-11-45 Bodeli (Baroda Dist.); GS358 ♀ 22-11-45 Dabka (Baroda Dist.) ; GS537 ♀ 11-12-45 Nadiad environs (Kaira Dist.) ; GS1198 ♀+ 3-4-46 Dediapada (Rajpipla).

Measurements:	W	B	Tar.	T
2 ♂♂	223–235	35–38·5	65–76	108–124·5
4 ♀♀	217–237	35–36·5	75–76·5	106–127

Resident. Common. Breeding March to October. There is a widely current folk belief in Gujarat, Saurashtra and Kutch that if the eggs in a lapwing's nest lie with the small ends pointing inwards, a good monsoon is assured. This must be a comforting augury since certainly by far the larger number of eggs are placed in this way, regardless of the vagaries of the monsoon!

Hoplopterus malabarica (Bodd.). The Yellow-wattled Lapwing

Specimens collected. Gujarat: GS230 ♀, GS231 ♀ 11-11-45 Jambughoda ; GS442 ♂ 30-11-45 Cambay town environs.

Elsewhere noted: Kutch: Bhuj; Mandvi; Khari Rohar; Anjar; Jakhau; Mata-no-Madh etc. Saurashtra: Kodinar; Dalkhania. Gujarat: Bodeli (Baroda Dist.); Kharaghoda.

Measurements:	W	B	Tar.	T
1 ♂	205	29	64	84
2 ♀♀	197–205	28–28·5	57–62	75–80

Resident. Fairly common. Usually on arid waste land and fallow fields. Possibly a local migrant to some extent, as it is in Sind. The black cap sometimes stands up like a miniature tableland ' above the head, reminiscent of long erect pile of a silken carpet! Breeds in Kutch, and presumably also over the rest of the area, April to August.

Pluvialis squatarola (Linn.). The Grey Plover

No specimens collected. Noted: Mandvi (Kutch).

Winter visitor. Not common, but frequent. Usually a couple, or small flocks, mixed with other waders on the seashore. Hume obtained it in northern Gujarat on the shores of the Rann, and saw specimens from other places along the coasts of Kutch and Kathiawar (*S.F.*, iv : 11).

On 27 August a pair, evidently just arrived, was still in summer plumage with black underparts. In winter plumage (underparts white) the black axillaries show up in flight as an oval black patch providing an easy means of field identification.

Pluvialis dominica fulva (Gmelin). The Eastern Golden Plover

Specimen collected : Kutch: KS355 ♂ 9-3-44 Mandvi.
Elsewhere noted : Mithapur (near Dwarka, Saurashtra).

Measurements :	W	B	Tar.	T
1♂	165	30·5	45	60·5

Winter visitor. In large flocks of 50 + on grassy, muddy shores of jheels and brackish lagoons, and tidal mudflats.

Charadrius leschenaulti leschenaulti Lesson. The Large Sand Plover

No specimens collected. Noted : Kutch : Mandvi; Kandla; Lakhpat; Saurashtra: Kodinar.

Winter visitor in small numbers. Earliest date 24 August (Mandvi, Kutch). Usually in twos and threes mixed with flocks of lesser Sand Plovers on the seashore and about salt pans, etc.

Charadrius dubius curonicus (Gmelin).

Specimens collected : Kutch: KS158 ♀ 4-9-43 Nakhatrana; KS315 ♀, KS316 ♀ 4-10-43 Khavda (Pachham I.).

Measurements :	W	B	Tar.	T
3 ♀♀	113–126·5	17–18·5	21–26	56·5–63·5

Charadrius dubius jerdoni (Legge)

Specimens collected : Gujarat: GS291 ♀ 18-11-45 Dabka (Baroda Dist.); GS594 ♀, GS595 ♂ 16-12-45 Vaghjipur (Mehsana Dist.).

Measurements :	W	B	Tar.	T
1 ♂	108	17	26	53·5
2 ♀♀	110	16	26	53–55·5

The two races of the Little Ringed Plover are difficult to differentiate in winter plumage except on size and therefore in cases of overlap, more or less arbitrarily.

C.d. curonicus winter visitor; *C.d. jerdoni* resident. Fairly common over the entire area. Parties and small flocks (in winter) frequenting muddy shores of tanks, ponds and tidal creeks, etc.

Charadrius alexandrinus alexandrinus (Linn.). The Kentish Plover

Specimens collected : Gujarat: GS126 ♀, GS127 ♂ 5-11-45 Bodeli (Baroda Dist.). Elsewhere not specially noted; possibly confused with *Charadrius dubius.*

Measurements :	W	B	Tar.	T
1 ♂	110	20	26	46
1 ♀	113	20	28	45

In winter plumage very similar to non-breeding and immature *Charadrius dubius.* The two may be distinguished as follows :

Charadrius alexandrinus	*Charadrius dubius*
1. Three outer pairs of rectrices all white.	1. Only the outermost pair all white ; 2nd and third pairs partly brown.
2. Shafts of all primaries white.	2. Shaft of first primary only white.
3. Brown pectoral band widely broken.	3. Pectoral band unbroken.
4. Legs black.	4. Legs yellow.

The Lesser Sand Plover, *Charadrius mongolus atrifrons* resembles *C. alexandrinus* but it has only the outermost pair of rectrices white with a brown spot on inner web near tip. The second pair is sooty brown except for fringe of extreme tip which is white. The pectoral band is usually broken as in *alexandrinus,* and its legs are also black.

That the Kentish Plover is a resident in Saurashtra, and possibly also in Kutch, has only lately been proved by the discovery of its breeding in Bhavnagar and Porbandar by K. S. Dharmakumarsinhji in June 1946 and subsequent years. (*JBNHS,* 46 : 728/29 ; 48 : 809/10). No specimens are available to determine this resident race. Stuart Baker records typical *alexandrinus* breeding in Sind, while the smaller *seebohmi* is known to breed in Ceylon.

In winter the population is no doubt augmented by influx of migrants from beyond Indian limits. Seen on the sea coast, in mixed flocks with other small waders ; also inland, on river banks and shores of tanks and jheels.

Charadrius mongolus atrifrons Wagler. The Pamirs Lesser Sand Plover

No specimens collected. Noted : Kutch : Mandvi ; Kandla ; Saurashtra : Kodinar ;Flocks on seashore in winter, often mixed with other small waders. Common.

Subfamily SCOLOPACINAE : Curlews Sandpipers, Snipe, Woodcock

Numenius arquata orientalis Brehm. The Eastern Curlew

Specimens collected : Kutch : KS367 ♂ 12-3-1944 Mandvi ; Gujarat : GS260♀ 17-11-45 Dabka (Baroda Dist.)

Elsewhere noted : Kutch : Kandla ; Bhuj ; Mandvi ; Khavda ; Saurashtra : Bedi Bunder ; Dwarka ; Mithapur (Okhamandal) ; Gujarat : Cambay town environs ; Kanewal (Cambay) ; Radhanpur ; Viramgam ; Kharaghoda.

Measurements :	W	B	Tar.	T
1 ♂	288	157	83	110
1 ♀	310	187	89	109

Usually seen solitary or in small parties on the seashore, tidal mudflats, lagoons, &c. Butler says they arrive in N. Gujarat as early as mid July and frequent tanks and jheels in immense flocks often of 2–300 birds (*S.F.*, iv : 16—1876). So far believed to be a winter visitor only, but considering the reiterated claim by local shikaris, that it breeds in Kutch, and also the fact that birds may be seen about Kandla and Navlakhi in the

Gulf of Kutch practically throughout the year, further investigation seems desirable, and particularly after the discovery of breeding of the Avocet.

The specimen of 12 March was freshly moulted. Its stomach contained remains of small crabs with a quantity of sand grains.

Numenius phaeopus [**phaeopus** (Linn.)]. The Whimbrel

No specimens collected.

Noted: Kutch: Kandla; Mandvi; Saurashtra: Navlakhi (Morvi); Mithapur (Okhamandal):

The same remarks apply to it as to the Curlew, and its breeding in the Great Rann is not improbable. It is plentiful on the muddy shores of the numerous creeks and channels in the Gulf of Kutch, between Navlakhi and Kandla, in June, July and August and also the rest of the year.

Limosa limosa limosa (Linn.). The Blacktailed Godwit

Specimens collected: Gujarat: GS1043 ♂+, GS1044 ♀ 19-3-46 Kharaghoda.

Elsewhere noted: Kutch: Mandvi; Bhuj; Rudra Mata.

Measurements:	W	B	Tar.	T
1 ♂	218	111	79	78·5
1 ♀	220	118	85	80

Winter visitor. Earliest date August 23 (Mandvi); latest March 22 (Bhuj). Lester noted it in numbers as late as April 17 in Kutch, and 3 birds in winter plumage on 7 July. Not uncommon, and even abundant at tanks, lagoons, etc. Flocks sometimes of over 50. The male specimen of 19 March was partially moulted into summer plumage and its gonads showed a slight development. Basal portion of bill salmon-yellow in GS1043 (♂), flesh pink in GS1044 (♀); blackish for *ca.* 50 mm. at tip. Both birds were very fat indicating readiness to emigrate shortly.

Limosa lapponica lapponica (Linn.). The Bartailed Godwit

Specimen collected: Kutch: KS199 ♀ 11-9-43 Kandla.

Elsewhere noted: Bhuj.

Measurements:	W	B	Tar.	T
1 ♀	222	109	57	73·5

Winter visitor. Much less common than the last. Earliest date August 5 (Kandla). Small numbers feeding in the shallow salt pans along the creek.

When the two species are seen together in the field, the shorter tarsus of the Bartailed Godwit is an easily noticeable and diagnostic feature.

Tringa erythropus (Pallas). The Spotted, or Dusky, Redshank

Not met with by the Surveys. According to Capt. Butler (*S.F.*, iv: 18—1876) not uncommon in N. Gujarat, occurring along the edges of most of the tanks in the cold weather.

Tringa totanus eurhinus (Oberholser). The Redshank

Specimens collected: Kutch KS196 ♂ 10-9-43 Kandla; KS369 ♂ 13-3-44 Mandvi.

Measurements:	W	B	Tar.	T
2 ♂♂	158–160	45–49	49–50·5	62·5–69

Common winter visitor. Earliest date 23 August (Mandvi, Kutch); latest 22 April (Nir, Gt. Rann). Singly, in small parties and flocks often mixed with Dunlins, Curlew Stints and other small waders, feeding in the shallow brine of salt pans, on the squelchy mud along tidal creeks, and also on the margins of jheels, puddles, etc. The September specimen was in heavy general moult involving body, rectrices and remiges; the March bird was excessively fat, indicating impending emigration. A disabled bird with freshly injured wing was caught, examined and measured on 22 April when it was in perfect breeding plumage.

The stomach of a specimen feeding in a salt pan contained over 90% grit, with some brown mucous and 2 or 3 small crimson threadlike, segmented worms 5–7 mm. long. When alarmed or suspicious the bird bobs violently up and down.

The large numbers of Redshanks that collect, together with thousands upon thousands of Ruffs and Reeves and assorted small waders, on the squelchy mud and shallows at the mouth of the Banas River opposite Dhutari Mata in the Little Rann of Kutch in March, prior to emigration, is a sight worth journeying a long way to see!

Tringa stagnatilis (Bechstein). The Marsh Sandpiper

Specimens collected: Kutch: KS327 ♀, KS328 o ? 10-10-43 Kandla; KS391 ♂ 21-3-44 Bhuj environs.

Elsewhere noted: Kutch: Nakhatrana; Khavda; Mandvi; Khadir I., etc. Gujarat: Radhanpur; Rajpipla, etc.

Measurements:	W	B	Tar.	T
1 ♂	142	47	56	58
1 ♀	145	44	54	60

Winter visitor. Earliest date 4 September (Nakhatrana, Kutch); latest 31 March (Rajpipla). A perfect miniature of the Greenshank. Seen singly or in parties and small flocks at inland waters and swamps, and about salt pans, frequently in company with other sandpipers and stints.

Tringa nebularia (Gunnerus). The Greenshank

Specimens collected: Gujarat: GS183 ♂ 8-11-45 Bodeli (Baroda Dist.); GS624 ♀ 17-12-45, GS643 ♀ 18-12-45, GS674 ♂ 20-12-45 Vaghjipur (Mehsana Dist.).

Measurements:	W	B	Tar.	T
2 ♂♂	189–198	59-64	59–62	76–83
2 ♀♀	200–205	61–65	61–62	79.5–81

Common winter visitor to Kutch, Saurashtra and Gujarat. Earliest date 23 August (Mandvi, Kutch). Usually seen singly at tanks, tidal creeks, rivers and puddles. The crop of a specimen feeding at a drying-up muddy pond contained a frog, larger than what would seem negotiable by the slender bill and gullet of the bird!

Tringa ochropus Linn. The Green Sandpiper

Specimens collected: Gujarat: GS182 ♂ 8-11-45 Bodeli (Baroda Dist.); GS596 ♂ 16-12-45 Vaghjipur (Mehsana Dist.); SD137 ♀ 3-3-48 Galkund (Surat Dangs). Saurashta: GS995, o ? 15-3-46 Dalkhania (Amreli Dist.).

Elsewhere noted ; Kutch : Mandvi ; Bhuj ; Nakhatrana ; Anjar, Lakhpat ; Khadir I. ; Gujarat : Baroda ; Cambay ; Radhanpur ; Palanpur ; Ahmedabad ; Viramgam ; Kharaghoda; Rajpipla ; Waghai and Mahal (Surat Dangs). Saurashtra : Dhari (Amreli Dist.).

Measurements :	W	B	Tar.	T
2 ♂♂	143.5–144	40	33.5–36.5	57–61
1 ♀	147	41	35	60

Common winter visitor. Earliest date 13 August (Kutch) ; latest 17 April (Surat Dangs). Seen singly on all inland waters : jheels, tanks, ponds, ditches, etc. Butler (*S.F.*, iv : 18—1876) says it begins to arrive in N. Gujarat about the end of July.

Tringa glareola Linn. Spotted Sandpiper

Specimen collected : Gujarat : GS184 ♀ 8-11-45 Bodeli (Baroda Dist.).

Measurements :	W	B	Tar.	T
1 ♀	125	35.5	36	49

Common winter visitor to the entire area. Latest date 22 April (Nir, Great Rann). Frequents inland waters, inundated ploughed fields, brackish lagoons, etc. Rarely the seashore. Keeps singly, in small parties and sometimes flocks of 35 or so. Utters a sharp, quick-repeated *chip, chip, chip, chip* on the ground (at about 2 or 3 *chips* per second), and *pee-pee-pee* as it flies off.

Tringa cinerea [**cinerea** (Gülden.)] The Terek Sandpiper

No specimens collected.

Winter visitor. Earliest date 28 August (Mandvi, Kutch). In small numbers on the seacoast and brackish lagoons, in mixed flocks with sandpipers, etc.

Tringa hypoleucos Linn. The Common Sandpiper

Specimens collected : Kutch : KS232 ♀ 16-9-43 Anjar ; Gujarat : GS185 o ? 8-11-45 Bodeli (Baroda Dist.).

Measurements :	W	B	Tar.	T
1 ♀	119	30·5	23	63·5

Winter visitor to the entire area. Common, but usually singly or in scattered two and threes. Frequents inland waters as well as seacoast, particularly where rocky. Earliest date 4 August (Navlakhi, Saurashtra), but a few odd non-breeding individuals may stay over in their winter quarters throughout the year.

Arenaria interpres interpres (Linn.). The Turnstone

Specimen collected : Kutch : KS200 ♀ 11-9-43 Mandvi.

Elsewhere noted : Khavda (Pachham I., Great Rann).

Measurements.	W	B	Tar.	T
1 ♀	147	26	26	56

Winter visitor, as it is to the entire western coastline of India. Small parties in association with other waders on the seashore, not necessarily rocky. Once also seen at a village tank (a solo) a few miles inland from the Great Rann.

Capella stenura (Bonaparte). The Pintail Snipe

No specimens of the Pintail Snipe were obtained by the Surveys, but it doubtless occurs in small numbers, as in neighbouring areas. In the experience of Capt. Butler it was not very common in northern Gujarat (*S.F.*, v : 212—1877).

Capella gallingao gallinago (Linn.). The Common or Fantail Snipe

Specimen collected : Saurashtra : B47 ♂ 20-10-43 Dhari (Amreli Dist.).

Measurements :	W	B	Tar.	T
1 ♂	142	77	36	61·5

Winter visitor. Earliest date Sept. 16 (Anjar). Common throughout the area but only moderately and locally plentiful at seepage marshes from irrigation tanks, squelchy muddy and grassy borders of jheels, etc. In Kutch, where it was practically free from molestation by humans, birds sometimes in loose parties were frequently seen at the water's edge on open village tanks within a few yards of chattering women filling their household pots and cattle watering !

Capella minima (Brünnich). The Jack Snipe

Specimen collected : Kutch : KS331 ♂ 5-3-44 Chaduva (Bhuj Dist.).

Measurements :	W	B	Tar.	T
1 ♂	119	39·5	26	54

Winter visitor. Not common, but a few odd birds are usually put up in typical snipe country on the grassy, marshy margins of tanks, etc.

Scolopax rusticola rusticola Linn. The Woodcock

An example, the first ever seen or heard of in Kutch, was shot by Maharao Madansinhji near Chakar (Bhuj Dist.) on 19-11-42 (*JBNHS*, 43 : 661).

In January 1945 the late Sir Peter Clutterbuck, I.F.S. observed an individual at Hamirsar Tank, right in the middle of Bhuj City, on 3 consecutive days !

Since then a Woodcock has been taken at Mount Abu, curiously enough on 2nd July ! (1949—*JBNHS*, 48 : 585).

Calidris minutus minutus (Leisler). The Little Stint

Specimens collected : Kutch : KS206 ♂, KS207 ♀ 11-9-43 Kandla ; KS214 ♀ 13-9-43 Khari Rohar. Gujarat : GS124 ♀, GS125 ♂ GS138 ♀ 5-11-45 Bodeli (Baroda Dist.).

Measurements :	W	B	Tar.	T
2 ♂♂	94·5–98	21–21·5	20–21·5	40–42
4 ♀♀	98–102	23–25	20·5–23	36–42·5

Common winter visitor to the entire area ; well in by 11 Sept. (Kandla 1943) ; remnants by 2 April. Singly, in small parties or large flocks, usually mixed with other waders, on tidal mudflats, salt-pans, lagoons, and margins of jheels, etc.

Calidris temminckii (Leisler). Temminck's Stint

Specimens collected : Kutch : KS354 ♀ 9-3-44 Mandvi. Gujarat : GS186 ♀ 8-11-45 Bodeli (Baroda Dist.); GS625 ♀ 17-12-45 Vaghjipur (Mehsana Dist.).

Measurements :	W	B	Tar.	T
3 ♀♀	98–105	21·5–23·5	19·5–20	46·5–52

Winter visitor to the entire area, but less common and abundant than the Little Stint. Usually in mixed flocks with it and with other small waders.

Calidris testaceus (Pallas). The Curlew Stint or Pigmy Sandpiper

Specimens collected : Kutch: KS197 ♀ 10-9-43; KS201 ♂ 11-9-43 Kandla.

Measurements :	W	B	Tar.	T
1 ♂	137	43·5	31	52
1 ♀	133	45·5	32	47

Winter visitor. In large mixed flocks with dunlins, stints and other small waders, feeding in the shallow concentrated brine of salt pans, at brackish lagoons, tidal mudflats etc. When newly arrived in autumn, many individuals still have odd feathers of the summer plumage on the body which facilitates their differentiation in the field from dunlins. In winter plumage these two species are easily confused. Both the specimens were excessively fat and with freshly moulted remiges and rectrices.

Calidris alpinus alpinus (Linn.). The Dunlin

Specimens collected: Kutch: KS198 ♀ 10-9-43, KS202 ♀ 11-9-43 Kandla.

Measurements :	W	B	Tar.	T
2 ♀♀	120–123·5	40·5–41	26–27·5	47–51·5

Common winter visitor to the seaboard and perhaps the most abundant single species amongst the mixed flocks on the seashore, tidal mudflats, salt pans, etc. These flocks, doubtless also contain examples of the Broadbilled Sandpiper (*Limicola falcinellus*) not procured by the Surveys.

Philomachus pugnax (Linn.). The Ruff and Reeve

No specimens collected.

Noted : Kutch; Anjar; Khavda; Bhuj; Pung Bet (Little Rann). Saurashtra: Mithapur (Okhamandal); Gujarat: Baduchi and Kanewal (Cambay).

Winter visitor. Earliest date 16 September. (Anjar, Kutch). Fairly common in parties and small flocks, often in association with other small waders. In March, aggregations of thousands were present amongst the vast number of waders on the mudflats near Pung Bet where the Banas River debouches into the Little Rann of Kutch.

Family RECURVIROSTRIDAE : Stilt, Avocet.

Himantopus himantopus himantopus (Linn.). The Blackwinged Stilt

Specimens collected : Kutch : KS368 ♂+ 12-3-44 Mandvi ; Gujarat : GS243 ♀, GS244 ♀ 17-11-45 Dabka (Baroda Dist.).

Elsewhere noted : Kutch : Bhuj ; Lakhpat ; Chobari ; Khadir ; Anjar, etc. Gujarat : Cambay ; Dakor (Kaira Dist.) ; Vaghjipur (Mehsana Dist.) ; Radhanpur ; Viramgam, etc.

Measurements :	W	B	Tar.	T
1 ♂	251	78	131	84
2 ♀♀	244–248	77	120–122	82–83

Resident. One of the commonest waders on inland waters ; present in varying numbers at every swamp, jheel, puddle or tidal mudflat. Evidently given to marked local movements. Utters *chek.chek-chek-chek* like moorhen, of timbre and quality of the Redwattled Lapwing's call. Breeds March to August.

Recurvirostra avocetta [**avocetta** Linn.]. The Avocet

No specimens collected.

Status uncertain. Lester recorded it as ‘ very common ’ in Kutch in the winter of 1895–6 ; during the Kutch Survey, August 1943–April 1944, I did not come across the species at all. However, between 19 and 23 April (1944) I discovered a large breeding colony of over a thousand birds close to the ‘ flamingo city ’ in the Great Rann of Kutch, off Nir on Pachham Island. This is fully described in the *Journal of the Bombay Natural History Society* [45(3) : 420] and constitutes the first record of the Avocet breeding in peninsular India. The nearest breeding locality previously known was in northern Baluchistan. The eggs (maximum 4) were laid in a shallow depression on hard sunbaked ground, sometimes on a bed of mud pellets. 16 eggs average 49.25 × 35·0 mm. No specimens of the birds were collected so as not to disturb the flamingo colony hard by, but it remains to determine whether the Indian breeding birds are in any way different from the winter visitors from Europe.

The call, when the bird is agitated and flying overhead is a continuous *kleet-kleet-kleet* (about 3 per second) of the quality of the Stone Plover's calls.

Family ROSTRATULIDAE : Painted Snipe

Rostratula benghalensis benghalensis (Linn.). The Painted Snipe

No specimens. Flushed occasionally at several places in Kutch and Gujarat on grassy marshland bordering jheels. Not common or abundant.

A female shot by Capt. Butler on 16 September (?1875) near Deesa contained ovarian eggs. (*S.F.*, iv : 16).

Family DROMADIDAE : Crab Plover

Dromas ardeola Paykull. The Crab Plover

Not met with by the Surveys, and apparently a very rare vagrant. Col. Butler shot a specimen on a creek near Mandvi (Kutch) on 25-1-1877

(*S.F.*, v: 212). He notes that 'on the wing it reminds one of the jaçanas, flying with its legs stretched out behind, much in the same style as *Metopidius indicus.*'

Family BURHINIDAE: Stone-Curlews

Burhinus oedicnemus ssp. The Stone-Curlew

Specimens collected: Kutch: KS60 ♂+, KS61 ♂+ 13-8-1943 Bhuj environs. Gujarat: GS516 ♀ 9-12-45 Nadiad town environs (Kaira Dist.); GS647 ♂ 19-12-45 Vaghjipur (Mehsana Dist.); GS1059 ♂+ 20-3-46 Kharaghoda.

Elsewhere noted: Kutch: Mandvi; Nakhatrana; Anjar; Rapar. Saurashtra: Dwarka; Dalkhania (Amreli Dist.). Gujarat: Ajwa (Baroda Dist.); Cambay; Deesa (Palanpur); Galkund (Surat Dangs).

Measurements:	W	B	Tar.	T
4 ♂♂	223–227	44–46·5	82–88	115–116
1 ♀	217	46	81	107

These specimens are intermediate between the Indian race *indicus* and the paler and larger desert form *saharae* found in Rajputana and Sind.

Common. Affects open scrub jungle, dried-up tank beds and mango topes, etc. near villages. Noisy at evening dusk and before sunrise, and also on moonlit nights. I have described the call elsewhere as a sharp, high-pitched *pick-pick-pick-pick-pick-pick*, often ending in a slower-repeated *pick-wick*, *pick-wick*, *pick-wick*, etc. In winter, flocks of 8 to 10 birds were not unusual.

Breeds from April on. The August specimens had evidently lately finished breeding as they were in general moult with testes not yet back to non-breeding condition.

Esacus recurvirostris (Cuvier). The Great Stone Plover

Specimen collected: Kutch: KS120 ♂+ 27-8-43 Mandvi

Elsewhere noted: Kutch: Kandla. Gujarat: Dabka (Baroda Dist.); Golana, Cambay, on the Mahi and Sabarmati Rivers respectively.

Measurements:	W	B	Tar.	T
1 ♂	267	79	82	113

Fairly common—usually pairs--along the sea coast and larger rivers, and about salt pans. The specimen had lately finished breeding and was in general moult. K.S. Dharmakumarsinhji found it in Porbunder, Saurashtra and records one eating the eggs of a Kentish Plover from a nest (*JBNHS*, 48: 809/10).

Family GLAREOLIDAE: Coursers, Pratincoles

Cursorius cursor cursor (Latham). The Creamcolored Courser

Specimens collected: Kutch: KS304 ♂, KS305 ♀ imm. 2-10-43 Khavda (Pachham Island); Gujarat: GS690 ♂, GS691 ♀ 24-12-45 Patan (Mehsana Dist.); GS808 ♂ 2-1-46 Radhanpur; GS928 ♀ 16-1-46 Palanpur.

Elsewhere noted: Kutch. Mandvi. Gujarat: Deesa (Palanpur).

Measurements :	W	B	Tar.	T
3 ♂♂	160–171	30–31	52–60	63–68·5
3 ♀♀	162–166	29–31	55–57	65–66

One of the Kutch specimens (KS305) is in part immature plumage with wavy black subterminal bars to some feathers of the back and secondary wing coverts.

Not uncommon in sandy desert country sparsely sprinkled with mounds of windblown sand round little bushes of *Capparis*, hard sun-baked 'pats' and sandy fallow land bordering the Great and Little Ranns.

No satisfactory evidence as regards breeding in this area was obtained. Butler suggested that it is a winter visitor to N. Gujarat arriving about 28 September (*S.F.*, iv : 11).

Cursorius coromandelicus (Gmelin). The Indian Courser

Specimens collected: Kutch: KS56 ♂+ 13-8-43 Bhuj environs. Saurashtra: GS987 ♂+ 12-3-46 Kodinar. Gujarat: GS257 ♀+, GS258 ♂+ 17-11-45, GS316 ♂+ GS317 ♀+ 19-11-45 Dabka (Baroda Dist.); GS904 ♀+, GS905 ♂, GS906 ♂ 13-1-46 Deesa (Palanpur); GS1064 ♀+, GS1065 ♂+ 21-3-46 Kharaghoda.

Elsewhere noted : Kutch : Anjar ; Rapar ; Mundra ; Mandvi; Jakhau ; Chobari (Bhachau Dist.). Saurashtra : Dwarka, Mithapur ; Amreli. Gujarat : Patan (Mehsana Dist.); Nadiad (Kaira Dist.), etc.

Measurements :	W	B	Tar.	T.
7 ♂♂	(143) 150–161	(23) 26·5–28	(51) 53–57	(45) 56–61
4 ♀♀	151–163	28–30·5	56–57·5	56–64

The smaller measurements of a male (in brackets, above) refer to a particularly small (subnormal ?) individual—No. GS1065.

Common in fallow fields in sandy open cultivated country. Breeding March to August. Later specimens, though still with slightly developed gonads, were in post nuptial moult.

Family LARIDAE : Gulls, Terns

Larus ridibundus Linn. The Blackheaded Gull

Specimen collected : Kutch : KS357 ♂ 1st year 9-3-44 Mandvi.

Elsewhere noted : Kutch : Kandla ; Mata-no-Madh ; Nakhatrana ; Bhuj; Khadir Island ; Nir (Pachham I.). Saurashtra : Kodinar.

Measurements :	W	B	Tar.	T
1 ♂ (1st year)	310	47·5	49	113

Not uncommon in winter along the sea coast and on tidal creeks, lagoons and jheels. Earliest date 11 September (Kandla) ; latest 22 April (Nir, Great Rann). Of a gathering of 20–30 on the last date, none had acquired the black head of the summer plumage though 2 or 3 *L. brunnicephalus* in their company all had. Possibly these were all young birds who were not going to breed till the following year, though they hadn't the black subterminal bar to the tail as in the specimen.

Larus brunnicephalus Jerdon. The Brownheaded Gull.

Specimen (collected by Mr. Devkar): ♂ 4-4-47 Okha, Saurashtra.

Measurements:	W	B	Tar.	T
1 ♂	345	48	50	130

Noted: Saurashtra: Kodinar. Kutch: Nir (Pachham I., Great Rann)

Winter visitor. Apparently less common than *ridibundus*.

Larus fuscus taimyrensis Buturlin. The Eastern Herring Gull.

Specimens (by Mr. Devkar): 2 ♀♀ 4-4-47. Okha, Saurashtra.

Noted: Kutch: Kandla; Mandvi; Lakhpat. Saurashtra: Navlakhi.

Measurements:	W	B	Tar.	T
2 ♀♀	423–433	58–59	61	158–165

Winter visitor to the sea coast. Usually seen singly, also on tidal estuaries. One was observed wading into shallow surf and seizing a fairly large crab. He dropped it nervously, picked it up again, dropped it, and so on. After 3 or 4 re-captures, he removed it to the shore and smashed the carapace by repeated hammer blows with his bill, biting it and knocking it on the ground from time to time.

Larus argentatus cachinnans Pallas. The Yellowlegged Herring Gull.

No specimens collected. Observed around Kandla (Kutch), Navlakhi and Kodinar (Saurashtra) along the sea coast. Small numbers in March.

Chlidonias hybrida indica (Stevens). The Indian Whiskered Tern.

Specimens collected: Kutch: KS212 ♂ 12-9-43 Kandala. Gujarat: GS286 ♀ 18-11-45 Dabka (Baroda Dist.).

Elsewhere noted: Kutch: Bhuj environs; Anjar; Khavda & Nir (Pachham I.). Saurashtra: Dwarka; Mithapur. Gujarat: Ajwa (Baroda Dist.); Kharaghoda.

Measurements:	W	B	Tar.	T
1 ♂	229	36·5	23	66/77
1 ♀	218	32	23	66/79

Evidently a winter visitor. Seen at jheels, tanks and ponds. Earliest date 30 August (Bhuj environs); latest 22 April (Nir, Pachham I., Great Rann). On the latter date all the birds were in the black-bellied breeding plumage.

Hydroprogne tschegrava tschegrava (Lepechin). The Caspian Tern.

No specimens collected.

Noted: Kutch: Mandvi; Nir (Pachham I., Gt. Rann). Saurashtra: Mithapur (Okhamandal).

Winter visitor along the sea coast. Its large size and large coral red bill readily distinguish it from other terns.

Gelochelidon nilotica nilotica (Gmelin). The Gullbilled Tern

Specimens collected: Kutch: KS123 ♂ 28-8-43 Mandvi; Gujarat: GS287 ♂ 18-11-45 Dabka (Baroda Dist.).

Elsewhere noted: Kutch: Kandla; Khavda; Lakhpat; Chobari, etc. Sauashtra: Navlakhi (Morvi); Mithapur (Okhamandal). Gujarat: On Mahi, Sabarmati and other rivers, and large tanks and jheels.

Measurements:	W	B	Tar.	T
2 ♂♂	300–312	50	33–34	77–90/116·5–131

Winter visitor, and the commonest tern in the area. Was fairly abundant already in the first week of August (Kutch). The last date I have is 23 April (Nir, Gt. Rann) but the birds were still plentiful (in full breeding plumage) and it is not unlikely that they may breed in the neighbourhood. Seen on all waters— sea coast, tidal creeks, rivers, jheels, ponds.

Thalasseus bergii spp. The Crested Sea Tern

I have an unconfirmed sight record from Mandvi (Kutch) of a small flock, 13 March (1944).

Sterna aurantia J. E. Gray. The Indian River Tern

Specimens collected: Gujarat: GS193 ♂ 8-11-45 Bodeli (Baroda Dist.); GS549 ♀ 12-12-45 Saiat (Kaira Dist.).

Elsewhere noted: Saurashtra: Mithapur (Okhamandal). Many on a brackish lagoon with other terns. Gujarat: Radhanpur—on Banas River. At several places on Mahi, Sabarmati and other rivers.

Measurements:	W	B	Tar.	T
1 ♂	273	49	23	83/137
1 ♀	270	45	22·5	79/169

I can trace no record of its breeding in Gujarat, but it is not improbable that it does so on the sandbanks of some of the larger rivers.

Sterna melanogaster Temminck. The Blackbellied Tern

Specimen collected: Gujarat: GS550 ♀ 12-12-45 Saiat (Kaira Dist.)

Elsewhere noted: Bodeli (Baroda Dist.)—on Orsang River.

Measurements:	W	B	Tar.	T
1 ♀	233	43	15·5	66/155

Status uncertain. Probably resident and breeding on the sandbanks of some of the rivers.

Sterna albifrons ssp. The Little Tern or Ternlet

Specimens collected: KS203 o? imm. KS204 ♂ 11-9-43 Kandla.

Elsewhere noted: Kutch: Mandvi; Nir (Pachham I., Gt. Rann).

Measurements:	W	B	Tar.	T
1 ♂	170	37	17	42/59
1 o? imm.	173·5	31	17	45/53

In winter, when the specimens were collected, it is impossible to distinguish between the typical race and *saundersi* both of which wander freely in to each others range. Typical *albifrons* is known to breed near Bombay and also in NW. India and Iraq; *saundersi* breeds near Karachi. Ticehurst has reported on this group of terns in *Bull. B.O.C.* 49 : 66.

Small loose parties beating gracefully up and down over shallow salt pans and plunging like plummets, one after another, on small fish and crustaceans near the surface.

Family PTEROCLIDAE : Sandgrouse

Pterocles orientalis (Linn.). The Imperial or Blackbellied Sandgrouse

Specimens not preserved.

Winter visitor to Kutch but apparently only to the eastern districts (Wāgad), and there curiously spasmodic and local. Arrives about mid December ; departs about the 3rd week of February. The late Maharao Vijayarajji informed me that owing to a succession of drought years, its numbers had fallen considerably after 1930. He wrote ' In the good old days our bags varied from 40 to 60 birds. . . . I do not remember one gun ever shooting 100 birds in a day, nor a day's bag with more than one gun to have been 150 birds.'

Apparently not recorded from Saurashtra or Gujarat within recent years. Capt. Butler (*S.F.*, iv : 4) mentions one shot near Deesa (*ca.* 1876) from a party of 5, and Hume adds that it occurs in winter in the north-eastern portions of Kathiawar along the shores of the Rann. In 1877 Butler found it ' very abundant ' between Babra village (80 miles SW. of Deesa) and Mandvi in Kutch (*S.F.*, v : 222).

Pterocles indicus (Gmelin). The Painted Sandgrouse

Specimens collected: Kutch: KS90 ♂ 19-8-1948 Chaduva (Bhuj Dist.); KS388 ♂+ KS389 ♂+ KS390 ♀+ 18-3-44 Mata-no-Madh. Gujarat: GS641 ♂ + 18-12-45 Vaghjipur (Mehsana Dist.).

Elsewhere noted : Kutch : Nakhatrana ; Bhujia Fort.

Measurements :	W	B	Tar.	T
4 ♂♂	174–178	17–18	27–28	74–82
1 ♀	170	16	–	74

Resident. Sparingly distributed over the entire area in thinly scrubbed stony, hummocky or broken country. Usually seen in pairs or small parties. At a waterhole in Kutch large numbers arrived to drink in twos and threes or flocks of 8 to 10 after sunset and till it was quite dark. Gonads of the specimens indicated that breeding was in progress in March. Lester gives the season in Kutch as February/March.

Pterocles exustus ellioti Bogdanov. The Common Indian Sandgrouse

Specimens collected: Kutch: KS121 ♂+ KS122 ♀+ 28-8-43 Mandvi; Gujarat: GS455 ♂ 2-12-45 Golana (Cambay; GS718 ♂ 25-12-45 Patan (Mehsana Dist.); GS809 ♀ 2-1-46, Radhanpur ; GS1066 ♂+ 21-3-46 GS1082 ♂+ GS1083 ♀+, 22-3-46 Kharaghoda.

Elsewhere noted : Kutch : Bhuj ; Nakhatrana ; Anjar ; Bhachau ; Bela Island (Great Rann), etc. Saurashtra: Dwarka ; Okha ; Amreli. Gujarat: Nadiad environs (Kaira Dist., 2 specimens : H. C. Aldrich).

Measurements :	W	B	Tar.	T
4 ♂♂	177–185	18–18·5	25·5–28	105–133
2 ♀♀	172–177	15·5–17	25	85–104

Resident. Fairly common over the whole area, in dry open country and fallow fields, and semi-desert. Breeding was in progress during August/September, and also in March. In the Kaira Dist., Dr. Herschel C. Aldrich found it nesting between February and May. (*JBNHS*, 44: 124). The eggs (normally 3) are laid on the ground in an unlined scrape in open scrub country interspersed with cultivation.

Pterocles senegallus (Linn.). The Spotted Sandgrouse

Specimens collected: Kutch: KS293 ♂, KS294 ♀ 1-10-43 Khavda (Pachham Island).

Elsewhere noted: Kutch: Nānda (SW. of Adesar, on edge of Little Rann).

Measurements:	W	T
1 ♂	197	161
1 ♀	192	124·5

Normally only a winter visitor to Kutch, but within recent years small numbers have been reported throughout the year. On 1 October (1943) I observed 4 or 5 flocks aggregating 100+ birds in the Banni in north central Kutch. Its local Kutchi name *waku-waku* aptly describes the call. In the distance, when uttered by a number of birds together, the sound is reminiscent of the gurgling of a hookah being smoked. Also occurs sparingly in N. Gujarat and Kathiawar, but only in the neighbourhood of the Rann. (Hume, *S.F.*, iv: 4).

Family COLUMBIDAE: Pigeons, Doves

Treron phoenicoptera chlorigaster (Blyth). The Southern Green Pigeon

Specimens collected: Gujarat: GS609 ♀ 17-12-1945, GS640 ♂ 18-12-45, GS649 ♀ 19-12-45, GS684 ♂, GS685 ♀, GS686 ♀ 21-12-45 Vaghjipur (Mehsana Dist.); GS891 ♂ 11-1-46 Deesa environs (Palanpur); SD40 ♀+ 26-11-48, SD97 ♂+ 1-3-48, SD117 ♂+ SD130 ♀+ SD140 ♀+ 2-3-48 Galkund; SD149 ♂+ SD150 ♀+ SD151 ♂ SD152 ♀+ 4-3-48 Pandwa; SD316 ♀ juv. 14-3-48 Mahal; SD371 ♀+ 18-3-48 Mheskatri (SD series = Surat Dangs).

Not recorded from Kutch, though Hume suggests that it occurs (*S.F.*, iv: 2).

Measurements:	W	B	Tar.	T
7 ♂♂	187–201	22·5–24	24–29	104–120
10 ♀♀	181–202	20–24	24–28	97–116

Common and abundant everywhere in forest where plentifully scattered with peepal and banyan trees (*Ficus bengalensis* and *F. religiosa*), on the ripe figs of which it largely feeds. Drupes of the various *Zizyphus* and other species are also eaten. Breeding was in full swing during March, and is said to continue into April and May.

Columba livia ssp. The Blue Rock Pigeon

Specimens collected: Kutch: KS57 ♂+ KS58 ♂+ KS59 ♂+ 13-8-43 Bhuj environs. Gujarat: GS544 ♀ 11-12-45 Nadiad environs (Kaira Dist.); GS915 ♂+ 14-1-46 Deesa (Palanpur); SD214 ♂, SD215♂, SD216 ♂+ 7-3-48 Chinchli ; SD153 ♂+ 5-3-48 SD200♂+ 6-3-48 Pandwa (SD=Surat Dangs).

Measurements:	W	B	Tar.	T
9 ♂♂	223–232	24–26	30–33	106–115

I cannot see any consistent difference between birds marked *neglecta* (Bahawalpur) and *intermedia* (Central India) by Mr. Whistler, now in the B.N.H.S. Collection, nor in birds which according to the distribution of the races as given in the Fauna (v: 220/1) should belong to either race. With regard to two specimens collected in Gwalior, after diagnosing them as *intermedia*, Mr. Whistler writes *(JBNHS*, 41: 477) 'Both have the rump concolorous with the back. In colour and size these birds match my series from the Punjab, but until material is available from South India to allow the characteristics of true *intermedia* to be satisfactorily appreciated, I can neither define the ranges or differences of *intermedia* and *neglecta* nor identify individual birds with any satisfaction.'

A specimen trom Gersoppa (Mysore) in the Society's collection, which should be *intermedia*, cannot be distinguished from the Gujarat Survey specimens, nor from those from Bahawalpur or Gwalior labelled by Mr. Whistler as *neglecta* and *intermedia* respectively.

Two examples collected in Ceylon by the recent survey of the island are diagnosed by Mr. Whistler as *intermedia*, and he says they agree with his conception of that race on the material available [*Spolia Zeylanica*, 23 (3 & 4): 253)]. Thus he was apparently able to differentiate Ceylon birds from *neglecta*, whereas he could not do so with birds from peninsular India which to me look identical. It may be questioned, therefore, if there is any justification for extending the distribution of the race *intermedia* to include peninsular India. Birds from the extreme south (e.g. Travancore, etc.) *may* conceivably show greater affinity with Ceylon birds, but crucial material is lacking. At all events Stuart Baker's key to the subspecies *neglecta* and *intermedia*, *vis-à-vis* the distributions he assigns, is completely unworkable as such.

Common over the entire area, affecting buildings whether derelict ruins or in occupation, both within and on the outskirts of towns and in the neighbourhood of cultivation. A popular nesting site throughout the area is down the vertical shafts of disused wells, particularly katcha ones with earthen sides which offer an abundance of holes. Railway stations and goods yards where bags of grain are awaiting shipment are favourite resorts, and when the groundnut crop is harvested and left in the fields to dry, these pigeons take heavy toll of the pods.

Breeding continues more or less throughout the year.

Streptopelia orientalis meena (Sykes). The Rufous Turtle Dove

Specimens collected: Gujarat: SD26 ♀ 25-2-1948 Malegaon; SD61 ♂ 28-2-48, SD457 ♀ 25-3-48 Chikhli; SD437 ♂ 24-3-48 Sakalpatal, Surat Dangs.

Elsewhere noted: Gujarat: Dediapada (Rajpipla); Songadh (Navsari Dist.); Mahal and Galkund (Surat Dangs).

Measurements :	W	B	Tar.	T
2 ♂♂	202–205	23	27·5	131–139
2 ♀♀	192–195	22–23	26	122–129

Colours of soft parts: Iris orange; orbital skin, cere, gape, base of lower mandible, legs and feet magenta; terminal half of bill, and claws horny brown.

Winter visitor. Not uncommon in open glades and along cart tracks in bamboo and mixed deciduous forest. Singly, twos and threes or small parties. Excessively shy and wary.

Streptopelia risoria risoria (Linn.). The Indian Ring Dove.

Specimens collected; Gujarat: GS259 ♀+ 17-11-45, GS360 ♀+, GS361 ♂+ 22-11-45 Dabka (Baroda Dist.); GS916 ♂+ 14-1-46 Deesa (Palanpur).

Elsewhere noted: Kutch: Pung Bet (Little Rann, SW. of Adesar); Saurashtra: Kodinar; Dalkhania (Amreli Dist.). Gujarat: Ajwa and Bodeli (Baroda Dist.); Cambay; Nadiad (Kaira Dist.); Patan and Harij (Mehsana Dist.); Radhanpur, etc.

Measurements:	W	B	Tar.	T
1 ♂	160	20	23	132
2 ♀♀	168–171	20–23	24	123–125

Common and abundant in the drier parts of the area, frequently coincident with the Little Brown Dove. It has marked local migratory movements which have so far not been studied. On 20 November (1945, Dabka, Baroda) I have a note: 'Flocks of up to 20+ flying high up in the air, directly and purposefully as if migrating'. I have observed such flights at other places also in the cold season, and so have other observers.

Breeding was in progress between November and April, and it continues more or less throughout the year.

Streptopelia tranquebarica tranquebarica (Hermann). The Red Turtle Dove

Specimens collected: Gujarat: GS61 ♀+ 31-10-1945, GS108 ♀+, GS109 ♂+ 2-11-45 Ajwa (Baroda Dist.).

Elsewhere noted: Kutch: Bhuj; Mandvi; Anjar; Bhachau; Rapar; Nir (Pachham Island). Saurashtra: Amreli; Dhari; Kodinar, etc. Gujarat: Nadiad (Kaira Dist.); Cambay; Patan (Mehsana Dist.); Radhanpur; Deesa (Palanpur); Kharaghoda, etc.

Measurements:	W	B	Tar.	T
1 ♂	145	18	21	92
2 ♀♀	137–139	17·5–18·5	20	84–87

The least common dove. Capriciously and sparingly distributed in the drier parts, frequently alongside the Little Brown and the Ring Doves, and unaccountably absent at other times. Usually in pairs or small parties, but on one occasion (Palanpur, 16 January) a flock of 20+ was met with, gleaning in a stubble field. Breeding was in progress between October and December. Capt. Butler (*S.F.*, iv: 3) took a nest containing 1 fresh egg near Deesa on 8 July, and saw several others in the same month and in August and September. As in other doves the season is undefined and evidently covers more or less the entire year.

Streptopelia chinensis suratensis (Gmelin). The Spotted Dove

Specimens collected : Gujarat: GS499 ♀+, GS500 ♂+ 7-12-1945 Cambay town environs; GS545 ♀+ 11-12-45 Nadiad town environs (Kaira Dist.) SD191 ♀ 6-3-48 Pandwa; SD267 ♂+ 12-3-48 Laochali; SD292 ♂+, SD293 ♀+ 14-3-48 Mahal (Surat Dangs). Saurashtra: GS1023 ♀ 16-3-46 Dalkhania (Amreli Dist.).

Absent in Kutch.

Measurements :	W	B	Tar.	T
2 ♂♂	138–141	19	23·5–24	134–135
4 ♀♀	133–143	19·5–21	22·5–24	123·5–133

Common in well wooded areas; absent or scarce in drier scrub-and-bush country where the Little Brown Dove completely replaces it. A bird calling vigorously *Kroo-krūk-krūk-kroo*, etc., proved on dissection to be a female!

Breeding was in progress from October to March, and presumably continues more or less throughout the year.

Streptopelia senegalensis cambayensis (Gmelin). The Little Brown Dove

Specimens collected : Kutch: KS34 ♀+ 10-8-43, KS138 ♂+ 31-8-43 Bhuj. Gujarat: GS431 ♀+, GS432 ♂+, GS433 ♂+, GS434 ♀+ 30-11-45, GS493 ♂+ 6-12-45 Cambay town environs.

Measurements :	W	B	Tar.	T
3 ♂♂	130–137	17·5–19	20–21·5	112–119
3 ♀♀	126–134	17–19	20–20·5	105–113

Common over the entire area in drier facies than the Spotted Dove, and addicted particularly to semi-desert and stony euphorbia and scrub-and-bush country, In many localities it is coincident with the Ring Dove.

All the specimens were breeding. The season continues practically throughout the year, and the birds commonly build on cornices and rafters within occupied dwellings, regardless of the comings and goings of the human inmates.

Chalcophaps indica indica (Linn.). The Indian Emerald Dove

Specimens collected: Gujarat: GS1287 ♂+ 17-4-46 Mahal; SD 433 ♀ 22-3-48 SD455 ♂ 24-3-48 Waghai (Surat Dangs).

Elsewhere noted. Gujarat: Songadh (Navsari Dist.); Piplaidevi; Pimpri; Laochali etc. (Surat Dangs).

Measurements:	W	B	Tar.	T
2 ♂♂	154–156	24–25·5	27–28·5	93–99
1 ♀	149	22	26	89

Songadh in Navsari District, appears to be the most northerly record for this species on the western side of India, though ecologically it is more than probable that it extends through Rajpipla and at least to the Narbada River. Eastward my notes record it from Chaurakund in Amraoti Dist. (Madhya Pradesh), about the same latitude as Songadh.

Solos or pairs in moist deciduous mixed bamboo forest. In heavy general moult in March.

No. SD455 had all primaries of one wing except the first, and many of the secondaries missing. The bird flopped helplessly on the ground as though 'injury feigning' and must apparently have been in this condition for some days since it was considerably emaciated. The casualty may be the result of accidental impact with an outhanging branch of the spiny 'katas' bamboo (*Dendrocalamus strictus*), characteristic of this locality, while the bird was flying at top speed through the forest as it usually does. In the Travancore Survey Report (*JBNHS*, 39 (2): 339), I have recorded a case of a bird dashing itself to death against the whitewashed wall of a building abutting on forest.

Family PSITTACIDAE: Parakeets

Psittacula eupatria nipalensis (Hodgson). The Large Indian Parakeet

Specimens collected: Gujarat: GS1243 ♂+, GS1244 ♀+, 12-4-46 Waghai; GS1280 ♀ 17-4-46 Mahal (Surat Dangs); SD62 ♂+, SD63 ♂ 28-2-48 Chikhli; SD154 ♀ 5-3-48 Pandwa; SD318 ♂, SD319 ♂, SD320 ♂ 16-3-48 Mheskatri; SD386 ♂ SD387 ♂ 20-3-48 Sarwar (Surat Dangs).

Elsewhere noted: Gujarat: Gangasagar (Palanpur); Juna Rajpipla. Absent in Kutch and presumably also in Saurashtra (?)

Measurements:	W	B	Tar.	T
2 ♂♂	200–217	33–39	20–22	(179) 220–310
3 ♀♀	192–212	33–35·5	21–21·5	206–296

Commmon in the Surat Dangs. General moult in March. Odd birds had enlarged gonads in February, and also in April.

A place called Dumkhal (*ca.* 15 miles E. of Juna Rajpipla) is locally famous for its large parakeets which are exported far and wide and evidently especially prized by fanciers!

Psittacula krameri borealis Neumann. The Roseringed Parakeet

Specimens collected: Kutch: KS31♂ 10-8-43 Bhuj environs; Gujarat: GS45 ♂, GS46 ♂, GS47 ♂, GS48 ♂ 30-10-45 Ajwa (Baroda Dist.); GS303 ♂, GS304 ♀ 19-11-45 Dabka (Baroda Dist,); GS1060 ♀+, GS1061 +, 20-3-46 Kharaghoda; SD158 ♂+ 5-3-48 Pandwa; SD280 ♂+ 12-3-48 Laochali (Surat Dangs).

Measurements:	W	B	Tar.	T
5 ♂♂	170–180	25–28·5	18–19	157–245
2 ♀♀	166–168	24·5–25·5	18·5–19	166–183

Lower mandible largely black in 10 out of the 11 specimens, but the larger measurements and distribution, as arbitrarily fixed by Whistler (*JBNHS*, 37: 752) south to 20° N. lat., places this series with the northern race *borealis*.

Common throughout the area. Breeding was in progress during August and September, as well as in March/April. Holes in walls of buildings, ancient and crumbling as well as occupied ones—even in the heart of noisy bazaars—are freely patronized as nest sites.

Psittacula cyanocephala bengalensis (Forst.). The Blossomheaded Parakeet

Specimens collected: Gujarat: GS305 ♂ 19-11-1945, GS331 ♂ 20-11-45, GS352 ♀ 21-11-45, GS373 ♂ 22-11-45 Dabka (Baroda Dist.); GS635 ♀ 18-12-45, GS653 ♂ 19-12-45 GS670 ♀ 20-12-45 Vaghjipur (Mehsana Dist.); GS889 ♂, GS890 ♂ 11-1-46 Deesa (Palanpur); GS952 ♂ GS953 ♀ 20-1-46 Balaram (Palanpur); SD321 ♂ 16-3-48 Mheskatri; SD465 ♂ 25-3-48 Chikhli (Surat Dangs).

Measurements:	W	B from cere	Tar.	T
9 ♂♂	135–145	20–23	14·5–16	187–210
4 ♀♀	133–138·5	19–20·5	14–15	124–167 (2 msd.)

Fairly common in wooded country. The Survey did not come across it in Kutch, but Hume apparently had records thence. (*S.F.*, iv: 458).

General moult in March. No indication of breeding from gonads of specimens. Race as arbitrarily fixed by Whistler (*JBNHS*, 37: 753) for birds north of 20° N. latitude.

Family CUCULIDAE: Cuckoos

Clamator jacobinus [pica (Hempr. & Ehr.)]. The Pied Crested Cuckoo

Specimens collected: Kutch: KS43 ♀+ 11-8-43 Bhujia Fort; KS50 ♀+ 12-8-43 Bu environs; KS319 ♂ juv. 5-10-43 Nir (Pachham Island). Gujarat: GS32 ♂, GS33 ♀ juv., GS34 ♀ 29-10-45 Ajwa (Baroda Dist.); GS170 ♂ 8-11-45 Bodeli (Baroda Dist.).

Measurements:	W	B	Tar.	T
2 ♂♂	149–150	25·5–27	25–27	165–166
4 ♀♀	143–150	25–27	26–28	166–172

On measurements the above series belongs to the northern (African) race *pica* which is believed to visit India during the SW. monsoon months. Fairly common at this season throughout the area. The October and November specimens were fat, and presumably preparing to emigrate.

Breeding was in progress in July/August. The common fosterer in Kutch is *Argya caudata*; in Gujarat *Argya caudata* and *Turdoides somervillei.*

Cuculus varius varius (Vahl). The Common Hawk-Cuckoo

Specimen collected: Gujarat: GS171 ♀ 8-11-1945 Bodeli (Baroda Dist.).

Elsewhere noted: Pavagadh, Champaner (Panchmahals Dist.); Waghai, Galkund, Mahal (Surat Dangs).

Not observed in Kutch, but recorded thence by Hume (*S.F.*, iv: 460).

Measurements:	W	B	Tar.	T
1 ♀	195	26	26	159

Apparently moves about a great deal with the seasons, but also is possibly much more widely distributed and common as a resident, though apt to be overlooked when silent.

Cuculus canorus ssp. The Cuckoo

Specimens collected: Kutch: KS27 ♂+ 9-8-43 Bhujia Fort; KS76 ♀+ 17-8-43 Chaduva (Bhuj Dist.); Saurashtra: B46 ♀ 20-10-43 Dhari (Amreli Dist.).

Measurements:	W	B	Tar.	T
1 ♂	218	26	—	152
2 ♀♀	213–230	22–28	23–24	160–170

Subspecies apparently *telephonus*. A hepatic male from Bodeli (GS177) taken on 9-11-45 cannot be placed satisfactorily. It measures: W 209, B 27, Tar. 23, T 157 mm.

Status over the area as a whole uncertain. In Kutch apparently a rains (breeding) visitor, common during August but mostly gone by end September. Gonads of the August specimens were mature. These two examples, and several other solos, were observed busily walking about the ground on the bare stony hummocks in the environs of Chaduva where larks and pipits were breeding at the time, searching for nests to lay in. They were being constantly chivvied and chased about by the would-be victims. Capt. Butler (*S.F.*, iii. 460) found the Cuckoo common in the neighbourhood of Deesa during the rains and winter. One of his specimens was identified by Hume.

Cacomantis sonnerati sonnerati (Latham). The Indian Banded Bay Cuckoo

Specimens collected: Gujarat: GS1310 ♂+ 21-4-46 Galkund; SD159 ♂ 5-3-48 Pandwa (Surat Dangs).

Elsewhere noted: Gujarat: Juna Rajpipla; Waghai; Mheskatri.

Measurements:	W	B	Tar.	T
2 ♂♂	125	23–26	18	112–118

Uncommon. Very vocal and active on cloudy overcast days. Easily overlooked when silent. Its call is *wee-ti-tee-ti*, or *tee-ti-ti-ti*, rather like the '*crossword puzzle*' call of the Indian Cuckoo, but in a higher key and differently punctuated. In timbre it resembles the call of the Plaintive Cuckoo which, curiously enough was not met with in Gujarat, Saurashtra or Kutch. Capt. Butler also evidently failed to meet with the latter in N. Gujarat though he says it is not uncommon at Mt. Abu where it arives about the beginning of June (*S.F.*, iii: 461). The Bay Banded Cuckoo does not appear in his list at all.

Eudynamis scolopaceus scolopaceus (Linn.). The Koel

Specimens collected: Kutch: KS30 ♀+ 10-8-43 Bhuj environs; KS68 ♂+ 16-8-43 Chaduva (Bhuj Dist.). Gujarat: GS334 ♂ 20-11-45 Dabka (Baroda Dist.); GS917 ♂ 14-1-46 Deesa (Palanpur); Saurashtra: GS986 ♀ 12-3-46 Kodinar; GS1012 ♀ 16-3-46 Dalkhania (Amreli Dist.).

Measurements:	W	B	Tar.	T
2 ♂♂	182–195	32·5 (1)	32·5 (1)	188–189
3 ♀♀	181–189	29–31·5	33–34·5	171–180

Scarce in Kutch and confined to the larger towns where its chief fosterer *Corvus splendens* is abundant. In Gujarat also it keeps more to gardens in and about towns, and in the neighbourhood of villages where House Crows abound. Was breeding in Kutch in August.

Rhopodytes viridirostris (Jerdon). The Small Greenbilled Malkoha

Mr. Joseph Gabriel, an experienced assistant in the Bird Department of the Prince of Wales, Bombay, who was collecting birds with the Gujarat Ornithological Survey reported seeing an example at Ajwa on 31 Oct. 1945. I have no hesitation in accepting this sight record. That he did not confuse the bird with *Taccocua* is clear from his statement that the bill was greenish and not red. Unfortunately no specimens was obtained. This marks a considerable northward extension of the range of this species, limited by Baker to south of Ratnagiri.

Taccocua leschenaulti leschenaulti (Lesson). The Southern Sirkeer Cuckoo

Specimens collected: Gujarat: GS268 ♀ 17-11-45, GS336 ♂ 20-11-45 Dabka (Baroda Dist.); GS518 ♂ 9-12-45, GS531 ♂ 10-12-45 Nadiad environs; GS682 ♀ 21-12-45 Vaghjipur (Mehsana Dist.); GS921 ♀ 16-1-46 Palanpur; SD279 ♂ 12-3-48 Laochali (Surat Dangs).

Measurements :	W	B	Tar.	T
3 ♂♂	153–159	31·5–32·5	41·5–45	235–244
3 ♀♀	156–159	30–34·5	43·5–44	223–240

Iris brown. Orbital skin greyish brown. Bill cherry red, yellow at tip of upper mandible and less at tip of lower. Legs and feet brownish grey or plumbeous. Claws horny brown.

The specimens from north of Cambay — Nadiad, Vaghjipur and Palanpur — are slightly paler on the underparts, being particularly less rufous on the abdomen. The upper parts are also a trifle paler, suggesting, on the whole, passage into the Punjab race *sirkee*.

Fairly frequent in dry scrub country tall grass and secondary jungle. Runs along in amongst thickets and stones, head lowered, tail carried horizontally and parallel with the ground. On a fleeting glimpse in the distance very mongoose-like. Call: *kek-kek-kek-kerek-kerek-kerek* or *kick kick-kick*, etc., of sharpness and quality of call of Roseringed Parakeet or Goldenbacked Woodpecker. It is sometimes also reminiscent of the Barred Jungle Owlet's. The specimen of 17 November had a mature ovary.

Centropus sinensis parroti Sresemann. The Southern Crow Pheasant

Specimens collected: Kutch: KS89 ♀ 7-8-43 Chaduva (Bhuj Dist.). Gujarat: GS5 ♂ 28-10-45 Ajwa (Baroda Dist.); GS501 ♀ 7-12-45 Cambay town environs; GS722 ♀ 26-12-45 Patan (Mehsana Dist.); SD254 ♀ 11-3-48 Laochali; SD406 ♂, SD407 ♀ 21-11-48, SD417 ♂ 22-3-48 Pimpri (Surat Dangs).

Measurements :	W	B	Tar.	T
3 ♂♂	185–195	41–44·5	50–57	238–265
5 ♀♀	190–210	38–45	50–57·5	258–310

Common in Saurashtra and Gujarat. Rare in Kutch; only seen at Bhuj, Chaduva and Mandvi where it is said to have been introduced from

Jamnagar (hence called 'Jamnagar Crow') by the late Maharao Khengarji about 4 years previous to 1943. However, since Stoliczka (*J.A.S.B.*, xli, 1872) records an example on the Jhura Hills (Kutch) as long ago as November 1871, it is evident that the species existed here even before the introduction.

The female of 7 October was laying. Birds were in general moult (postnuptial) in October. The significance of larger size in females needs to be investigated.

Family Tytonidae : Barn Owl

Tyto alba stertens Hartert. The Barn Owl.

Specimens collected: Gujarat: GS811 ♀ 3-1-46 Radhanpur; ♀ 12-11-40 Nadiad, Kaira Dist. (coll. Dr. H. C. Aldrich).

Elsewhere noted: Dediapada (Rajpipla). Deesa (Palanpur. Butler, *S.F.*, iii : 449).

Measurements:	W	B	Tar.	T
1 ♀	315	37	70	125

These specimens in their more grey, less ochraceous upper parts match examples from Manipur, which are obviously also *stertens*. Burma birds are distinctly more rufous and ochraceous; less grey.

Recorded from Kutch by Lester, and also by Capt. A. Newnham (*JBNHS*, 2: 55—1837) and possibly less uncommon over the entire area than the records suggest. It is more nocturnal than most other owls, retiring into hollow trees and ceilings, etc., of crumbling, and deserted buildings during daytime, and is therefore seldom seen. The stomach of the Radhanpur specimen contained the skulls and other remains of two rats.

K. S. Dharmakumarsinhji found it breeding in Bhavnagar (Saurashtra) in October (1938—*JBNHS*, 41 : 174).

Family Strigidae : Owls

Otus bakkamoena ssp. The Collared Scops Owl.

No specimens obtained, but from its calls evidently fairly common in moist deciduous forest country in Gujarat. Its familiar mellow, monosyllabic call *wūt, wūt*, etc. repeated once every second or so, was heard after dusk, and intermittently more or less throughout moonlit nights (particularly in the early hours before dawn) at Songadh in Navsari District, and at Mahal, Galkund, Pandwa, Laochali and elsewhere in the Surat Dangs. In addition to this call it sometimes utters a slowly repeated *ack-ack-ack-ack*, etc. strung out for 5 seconds or so.

Bubo bubo bengalensis (Franklin). The Indian Great Horned Owl

Specimens collected: Kutch: KS252 ♂+ 20-9-43 Rapar. Gujarat: GS370 ♀+ 22-11-45 Dabka (Baroda Dist.); GS508 ♂+ 8-12-45 Pariej (Kaira Dist.); GS902 ♂+ 13-1-46 Deesa (Palanpur).

Elsewhere noted: Kutch: Anjar. Gujarat: Shedi River and

Virdi (Kaira Dist., specimens: H. C. Aldrich); Patan (Mehsana Dist.); Dediapada (Rajpipla); Mahal (Surat Dangs).

Measurements:	W	B	Tar.	T
3 ♂♂	375–390	44–45	69–76	189–195
1 ♀	420	45	75	227

Iris orange yellow; bill horny black, base and cere plumbeous; claws horny black.

Affects well wooded country with large shady mango and similar trees in the vicinity of villages. The call, heard soon after sunset and also at dusk is a far-carrying, hollow, *bu . . . bo* rather pleasant in comparison with the Brown Fish Owl's. Stomachs examined at 10 a.m., 10·30 a.m. and 6 p.m. were all empty! The gonads of the specimens were in various stages of development, but no direct evidence of breeding was obtained. K. S. Dharmakumarsinhji records a nest with 4 eggs in Bhavnagar (Saurashtra) in December (1938—*JBNHS*, 41 : 174).

Bubo coromandus coromandus (Latham). The Dusky Horned Owl

Specimens collected: Gujarat: GS379 ♂ 27-11-1945 Cambay town environs; GS737 ♀ 27-12-45 Patan (Mehsana Dist.); GS810 ♀ 3-1-46 Radhanpur; GS1045 ♂ 20-3-46 Kharaghoda.

Elsewhere noted: Gujarat: Virdi (Kaira Dist., specimen: H. C. Aldrich); Kanewal (Cambay). Evidently absent in Kutch.

Measurements:	W	B	Tar.	T
2 ♂♂	390–402	42–43	60–61	196–208
2 ♀♀	403–412	46–49	55–67	198–210

A very diurnal owl, often on the move and even hunting during daytime. One individual, when shot, was actively devouring a freshly killed shikra hawk (*Astur badius*). GS1045 was one of a pair together in the act of demolishing a freshly killed coot. When it was shot, its mate flew off carrying the booty with it! Besides coot's feathers the stomach of this specimen contained remains of large water beetles (*Dysticus*). I feel I have now decicively traced down the resonant, hollow 'pingpong-ball-bounce' call to this species. This call is reminiscent of a large hollow celluloid ball dropped from a height and allowed to bounce itself to silence, the sound getting fainter and quicker with each successive bounce.

Bubo zeylonensis leschenault (Temminck). The Brown Fish Owl

Specimens collected: Gujarat: GS507 ♂ 8-12-45 Pariej (Kaira Dist.); GS645 ♀, GS646 ♂ 19-12-45 Vaghjipur (Mehsana Dist.).

Elsewhere noted: Gujarat: Dabka (Baroda Dist.); Patan (Mehsana Dist.); Nadiad (Kaira Dist., specimen: H. C. Aldrich). Evidently absent in Kutch.

Measurements:	W	B	Tar.	T
2 ♂♂	420–443	50–54	80–90	206–210
1♀	425	50	75	207

The above series would, on the measurements given in F.B.I. (iv : 473) go with the race *hardwickii*. However, Ticehurst (*Ibis* 1923 : 236 and

JBNHS, 34 : 473) considers that only the one race *leschenault* is recognizable in India and both Whistler (*JBNHS*, 38 : 234) and Ripley (Checklist MS) concur. The typical race from Ceylon is differentiated on darker colour and smaller size—♂♀ W 365–383 (*Spolia Zeylanica*, 23 (3 and 4)—Aug. 25, 1944).

Not uncommon in wooded country in the neighbourhood of tanks and rivers. The eroded banks and scrub-covered ravines of the Mahi River near its mouth at Dabka (Baroda Dist.) provide an ideal habitat for this and the Great Horned Owl. Its characteristic call is an eerie, hollow, reverberating *boomo-boom* heard in the gloaming soon after sundown. The gonads of the specimens were undeveloped. Their stomachs contained remains of frogs and fish.

Glaucidium radiatum radiatum (Tickell). The Barred Jungle Owlet

Specimens collected : Gujarat: GS1133 ♀ 29-3-46, GS1155 ♂+ 30-3-46, GS1187 ♂ 2-4-46 Dediapada (Rajpipla); GS1208 ♀+ 7-4-46, GS1223 ♂ 9-4-46 Songadh (Navsari Dist.) ; GS1271 ♀+ 14-4-46 Waghai; GS1292 ♀+ 17-4-46 Mahal ; GS1308 ♂+20-4-46 Galkund (Surat Dangs); SD98 ♀ 1-3-48, SD106 ♂+, SD107 ♀+, SD108 ♀, SD109 ♀+, SD110 ♀+ 2-3-48 Galkund; SD169 ♀, SD170 ♂+, SD171 ♂+ 5-3-48 Pandwa; SD247 ♀+ 10-3-48 Laochali ; SD309 ♂+ 14-3-48 Mahal ; SD345 ♀ 17-3-48 Mheskatri (SD = Surat Dangs).

Measurements :	W	B	Tar.	T
8 ♂♂	124–134	18·5–21	25–27	66–71
12 ♀♀	128–135	17–20	23–27	62·5–71

Common in the Dangs in moist deciduous forest country, where the most usual bird associationss consist of *Crypsirina vagabunda*, *Dissemurus paradiseus* and this species. Its pleasant, distinctive and somewhat junglecock-like call is one of the commonest bird sounds here. It begins with a loud *kāo* repeated 2 or 3 times, followed by *kāo-kūk*, (or *kookūk*) *kāo-kūk*, *kāo-kūk*, and so on, in quickening tempo and lasting about 5 seconds. When calling the head is somewhat lowered giving the bird a hunch-back profile, and the tail is wagged laterally or swung from side to side. Breeding was in full swing in March and April.

Ninox scutulata ssp ? The Brown Hawk-Owl

No specimens obtained. Heard and seen at Songadh (Navsari Dist.) and in the Surat Dangs at Waghai, Mahal, Galkund, Pandwa, Laochali, Mheskatri, and other places. Not otherwise in Gujarat, or in Saurashtra. Absent in Kutch.

Its wing action and habit of sweeping upward to alight on a branch at the end of a flight is characteristically hawk-like. The call is a pleasant, almost musical *oo-ūk*, *oo-ūk*, *oo-ūk* uttered in runs of 6 to 20 (mostly of 9 to 13) with a break of ½ to 1 second between each run. Very vocal during moonlit nights, and answered by other individuals from all directions. It is particularly active in the early morning just prior to retiring for the day, and may then be seen hawking winged insects in mid-air like a flycatcher, springing up a few feet vertically for a capture and diving back to its perch on a tree stem.

Athene brama indica (Franklin). The Spotted Owlet

Specimens collected : Kutch: KS26 ♀+ 9-8-1943 Bhujia Fort; KS28 ♀+ 10-8-43 Bhuj town environs; Gujarat: GS89 ♂ 1-11-45 Ajwa (Baroda Dist.); GS188 ♂, GS189 ♀ 8-11-45 Bodeli (Baroda Dist.); GS738 ♀ 27-12-45 Patan (Mehsana Dist.); GS1025 ♂+ 16-3-46 Dalkhania (Amreli Dist.); GS1085 ♂+ 22-3-46 Kharaghoda; GS1224 ♀ 9-4-46 Songadh.

Elsewhere noted : Kutch : Chaduva ; Mandvi ; Khari Rohar ; Tuna. Saurashtra : Amreli town ; Bhavnagar (specimen : Dharmakumarsinhji). Gujarat : Cambay ; Nadiad (specimen : Aldrich) ; Vaghjipur, etc.

Measurements :	W	B	Tar.	T
4 ♂♂	154–160	20–22	31–33	72–77
5 ♀♀	155–164	20–20·5	32–34	76–85

The subspecies is attributed as per the boundary arbitrarily fixed at 20°N between the north Indian race *indica* and the south Indian *brama* (Whistler, *JBNHS*, 38 : 237).

Common. Breeding was in progress in Kutch during August; in Gujarat March and April. At Dediapada Rajpipla, (30 Mar.) 2 pairs had eggs in hollows in the trunk of the same Mhowa tree (*Bassia*) within 15 feet of each other. In another hollow in an adjoining bough was a Roller's nest containing 3 eggs !

Strix ocellata ocellata (Lesson). The Mottled Wood Owl

Specimens collected : Gujarat: GS871 ♀, GS872 ♀ 11-1-46 Deesa environs (Palanpur) ; GS1148 ♀ 29-3-46 Dediapada (Rajpipla) ; SD245 ♀ 10-3-48 Laochali (Surat Dangs).

Elsewhere noted : Gujarat : Dabka (Baroda Dist.) ; Patan (Mehsana Dist.) ; Galkund and Mheskatri (Surat Dangs). Absent in Kutch.

Measurements :	W	B	Tar.	T
4 ♀♀	345–357	38–41	61–65	179–193

The two usual calls of this owl are : (1) a mellow single hoot, and (2) a quavering eerie *chuhuaa*. In addition it occasionally utters a screech similar to that of the Barn Owl. This last needs confirmation. Spends the day dozing in the branches of tamarind and such thickly foliaged trees. The gonads of the specimens provided no indication as regards breeding.

Asio flammeus flammeus (Pontoppidan). The Shorteared Owl

Specimens collected : Gujarat: GS288 ♀ 18-11-45 Dabka (Baroda Dist.) ; GS812 ♂, GS813 ♂, GS814 ♂, SG815 ♀, GS816 ♂, GS817 ♀ 3-1-46 Radhanpur ; SD143 ♀, SD144 ♀ 4-3-48 Galkund (Surat Dangs).

Elsewhere noted : Mandvi (specimen : M. K. S. Fatehsinhji) ; Gujarat : Asamli, Kaira Dist. (specimen : H. C. Aldrich). Saurashtra : Dwarka ; Dalkhania (Amreli Dist.).

Measurements ;	W	B	Tar.	T
4 ♂♂	314–325	30	46–48	141–150
4 ♀♀	305–320	29–31	43–48	143–148

Winter visitor. Not uncommon, but local and patchy. Perches on ground, for preference, at the base of bushes in tall grass and scrub country. On one occasion (Mehmedabad, Kaira Dist.) a loose assemblage of 10 or 12 birds was met with. In flight the pointed wing, white on the underside with black tips and a blackish crossbar at about half its length, is diagnostic of this migratory owl. Its speed on the wing is much greater than is apparent. The March specimens were very fat preparatory to emigration.

Hume (*S.F.*, iii : 450) records *Asio otus*, the Longeared Owl, from Kutch on the authority of Stoliczka.

Family CAPRIMULGIDAE : Nightjars

Caprimulgus indicus indicus Latham. The Indian Jungle Nightjar

Specimens collected : Gujarat: GS573 ♀ 12-12-1945 Saiat (Kaira Dist.) ; SD103 [♀] 2-3-48 Galkund ; SD173 ♂ 6-3-48, SD213♂+ 7-3-48 Pandwa.

Elsewhere noted : Gujarat: Dediapada (Rajpipla) ; Waghai, Malegaon, Mheskatri, etc. (Surat Dangs.) Absent in Kutch.

Measurements :	W	B	Tar.	T
2 ♂♂	196–198	22·5–23	16·5–17	136–144
2 ♀♀	187–189·5	20–23	16–18	127–129

Common in teak and mixed deciduous forest areas. Its presence is advertised by its distinctive calls, which are of two different kinds :

(1) *chuckoo-chuckoo-chuckoo*, &c, 3 to 12 or more times quick-repeated at about 2 calls per second. There is a pause, often of only a second or two—a mere break in the continuity—before the series is resumed ; pause . . . repeat. . . pause. . . . repeat, and so on, for considerable periods at a stretch, the birds being particularly vocal during their breeding season, and then on moonlit nights. The *chuckoo* calls are sometimes terminated by a pleasant, hollow-sounding *wowowowowowowo* tailing off at the end and reminiscent of an oil engine conking out.

(2) a not unpleasant *Uk . . . krookroo* repeated ad lib while the bird is perched lengthwise along a branch.

Only runs of either (1) or (2) are uttered at a time, and I have never heard a calling bird switch over from one type of call to the other. The significance of these alternate calls is not understood.

Stomachs contained grasshoppers predominantly. The testes of the March 7 specimens were enlarged to breeding size.

Caprimulgus europaeus unwini Hume. The European Nightjar

Specimens collected : Kutch: KS237 ♂ 17-9-43 Bhachau : KS255 o ? ; 21-9-43, KS261 ♀ 22-9-43, KS262 ♀, KS263 ♂, 23-9-43, KS264 ♂, KS265 ♂ 24-9-43 Rapar.

Not observed in Gujarat or Saurashtra.

Measurements :	W	T
4 ♂♂	176–192	117–134
2 ♀♀	183–184·5	126–130

A fairly common and abundant autumn passage migrant through Kutch by the Arabian route to its winter quarters in Africa. Earliest date 17 September (Bhachau). Abundant about the 3rd week of September (Rapar) ; nearly all gone by 3rd week October. Not observed on return passage between 3 March and 5 April. Presumably travels northward in spring by a different route.

All the specimens were excessively fat in preparation for the long journey ahead. They were silent except for an occasional quick-repeated *chuck-chuck-chuck-chuck* of the quality and volume of a House Gecko's call. Their stomachs contained dung beetles and crickets.

Caprimulgus mahrattensis Sykes. Sykes's Nightjar

Specimen collected: Gujarat: GS290 ♀ 18-11-45 Dabka (Baroda Dist.).

Elsewhere not noted.

Measurements:	W	B	Tar.	T
1 ♀	168	9 from forehead feathers	22	104 (dry)

The specimen was one of a pair flushed on dry grassland on the edge of a jheel. Hume obtained a specimen in N. Gujarat between Deesa and Suigam, and implies that it occurs in Kutch and Saurashtra as well (*S.F.*, iii: 455).

Caprimulgus monticolus monticolus Franklin. Franklin's Nightjar.

Specimens collected: Kutch: KS254 ♀ 21-9-43 Rapar. Gujarat: GS232 ♀ 11-11-45 Jambughoda. Saurashtra: GS990 ♂+ 15-3-46 Dalkhania (Amreli Dist.).

Elsewhere noted: Kutch: Mata-no-Madh. Gujarat: Dediapada (Rajpipla).

Measurements:	W	B	Tar.	T
1 ♂	202	19	18	123

The call of this nightjar, heard at dusk and during moonlit nights, is a characteristic sharp *sweesh* like a whip lash cutting the air. The September specimen was in heavy general moult; testes of GS990 (15 March) had enlarged to 5×4 mm. and the bird was evidently preparing to breed.

Caprimulgus asiaticus asiaticus Latham. The Common Indian Nightjar

Specimens collected: Kutch: KS49 ♂+ 12-8-43 Bhuj environs; KS139 ♂+ 1-9-43 Bhujia Fort.

Elsewhere noted: Kutch: Khari Rohar; Mata-no-Madh; Khadir, Bela and Pachham Islands. Saurashtra: Dwarka. Gujarat: Baroda Dist.; Golana, Cambay, etc.

Measurements:	W	B	Tar.	T
2 ♂♂	142–148	11–13	20–22	104 (1)

Fairly common. Its distinctive 'stone-on-ice' calls *chuck-chuck-chuck-chuck-chukr-r-r* were frequently heard at dusk after February. Although the testes of the specimens showed some enlargement (Aug./Sept.) they were both in heavy general moult which was presumably post-nuptial.

Family APODIDAE : Swifts

Apus melba ssp. The Alpine Swift

No specimens collected. Observed in Kutch (Nakhatrana, Bhachau, Bhuj) and Gujarat (Patan, Waghai, Fort Salher).

A bird of capricious movements, loose parties appearing suddenly from nowhere and after wheeling about at tremendous speed, hawking insects—chiefly around the tops of hills with cliffs and ancient forts— disappearing just as suddenly. They usually fly lower in cloudly overcast weather.

Apus affinis affinis (J. E. Gray). The Indian House Swift

Specimens collected: Kutch: KS44 ♀ juv., KS45 ♂ juv., KS46 ♀ juv. 11-8-1943 Bhujia Fort.

Elsewhere noted: Kutch: Anjar; Rapar; Khavda; Nir; Lakhpat: Mandvi; Adesar, etc. Saurashtra: Okha; Amreli; Dhari; Kodinar. Gujarat: Baroda City; Champaner; Dabka; Patan; Cambay town; Kapadvanj (Kaira Dist.); Viramgam; Surat City, etc.

The specimens (not measured) were taken from a nest of the Striated Swallow (*Hirundo daurica*) in an open cellar under a ruined rampart of Bhujia Fort, that had been appropriated by the swifts. The differential growth of the young indicated that brooding had commenced with the first egg.

A common species over the entire area, though somewhat patchy, with old established nest colonies under arches and gateways everywhere. Also in the angle of wall and ceiling in verandahs of buildings, whether ancient and deserted or occupied and even within noisy bazaars.

Cypsiurus parvus [batasiensis (J. E. Gray)]. The Palm Swift

No specimens collected. Observed in Gujarat at Ajwa and Bodeli (Baroda Dist.), Cambay town environs, Rajpipla, and elsewhere. Usually symbiotic with Palmyra palms (*Borassus flabellifer*), but curiously enough not as common locally as the palms would warrant, and even absent from some localities where the palms were abundant. K. S. Dharmakumarsinhji found several nests in Bhavnagar, Saurashtra, in May and June 1946, and believes it has established itself there quite recently (*JBNHS*, 46: 724).

Hemiprocne longipennis coronata (Tickell). The Crested Tree Swift

Specimens collected: Gujarat: GS1102 ♂+, GS1103 ♀+, GS1104 ♂+ 25-3-46 Juna Rajpipla.

Elsewhere noted: Gujarat: Songadh (Navsari Dist.); Galkund, Pimpri, etc. (Surat Dangs). Absent in Kutch.

Measurements:	W	B	Tar.	C.T.	O.T.
2 ♂♂	150–155	7·5	8·5–9	43–47	112–127
1 ♀	157	8	9	43	123·5

In small numbers, hawking insects over open deciduous forest, uttering the characteristic *whittuck, whittuck* calls. Breeding was in progress in March.

Family TROGONIDAE : Trogons

Harpactes malabaricus legerli Koelz. The Trogon

Specimens collected : Gujarat: ♂ 30-12-41, GS1241 ♂, GS1242 ♀ 12-4-46, GS1255 ♂ 13-4-46 Waghai (Surat Dangs); SD100 ♂ 1-3-48, SD104 ♂, SD105 [♂ juv] SD127 ♂, SD128 ♀ 2-3-48 Galkund; SD205 ♀ 7-3-48 Pandwa; SD289 ♀ 13-3-48 Ajwa; SD317 ♂ 14-3-48 Mahal; SD352 ♂ 17-3-48, SD360 ♂, SD361 ♀ 18-3-48 Mheskatri; SD391 ♂, SD392 ♀ 20-3-48 Sarwar (Surat Dangs).

Absent in Kutch. Not noted elsewhere in Gujarat, though may possibly occur in appropriate facies in the Rajpipla area. Possibly also in the Gir Forest of Junagadh, Saurashtra.

Measurements:	W	B	Tar.	T
12 ♂♂	130·5–142	19·5–21·5	15–17	155–184
6 ♀♀	130–135	18·5–21	15–17	160–176·5

In the young male (SD105) the crimson of the underparts is replaced by pinkish salmon. The chestnut central pair of retrices is not truncated as in the adult, but has the normal rounded tip. The black terminal band of the adult tail is lacking.

As pointed out by me (*JBNHS*, 48 : 806/7), this fine series is indistinguishable from specimens of *legerli* collected in Bastar (eastern Madhya Pradesh). Besides being larger than *malabaricus* from Travancore and Kanara, they differ from that race in the following respects :

Males brighter *yellowish* brown above, less suffused with chestnut, particularly on the upper tail coverts. Head and breast *sooty* black or *greyish* black as against deep black in southern birds. The females are also a brighter yellow-brown above than females of southern birds.

Specimens from the neighbourhood of Bombay city are intermediate. For the sake of convenience I have arbitrarily restricted the range of *malabaricus* to 'the Western Ghats country north to the 20th parallel' (loc. cit.).

Fairly common in the Dangs. Affects bamboo and mixed jungle in moist deciduous biotope. The male utters a throaty, rather musical (of oriole quality) *cue*, *cue*, *cue*, repeated unhurriedly usually 3 times, sometimes only twice. Sits bolt upright with dull coloured back studiedly turned to the observer thus obliterating itself effectively in its surroundings. In this position, moreover, the broad, square-ended tail (as broad as the body) makes it look like a bit of a branch or a dry leaf. When taking off, flutters from side to side, like a dove suddenly disturbed, with the pointed lateral tail feathers and primaries spread out and twisted round looking like the points of a star—reminiscent of the tail of the American Sage Grouse in display.

Most of the March specimens were undergoing body moult. In only one male (14 March) was a fair development of the testes noticed. No other evidence as regards breeding in this area was obtained.

Family ALCEDINIDAE : Kingfishers

Ceryle rudis leucomelanura Reichenbach. The Pied Kingfisher

Specimens collected: Gujarat: GS563 ♀ 12-12-1945 Saiat (Kaira Dist.); GS605 ♀, GS606 ♀ 16-12-45, GS636 ♂, GS637 ♀ 18-12-45 Vaghjipur (Mehsana Dist.).

Elsewhere noted: Kutch: Chaduva; Bhuj; Anjar. Saurashtra: Kodinar. Gujarat: Baroda and environs; Golana (Cambay); Radhanpur; Kharaghoda; Juna Rajpipla.

Measurements:	W	B (from forehead feathers)	Tar.	T
1 ♂	142	66	12	69
4 ♀♀	139–141	57·5–67·5	12–15	70–74·5

Fairly common. Pairs at irrigation reservoirs and rivers, hunting in the well known spectacular manner of hovering stationary and plunging headlong. No indication of breeding was provided by the gonads of the specimens. According to Lester, it breeds in Kutch in February and March.

Alcedo atthis bengalensis Gmelin. The Small Indian Kingfisher

Specimens collected: Saurashtra: B48 ♂ 20-10-43 Dhari (Amreli Dist.); Gujarat: GS111 ♂ 2-11-45 Ajwa (Baroda Dist.); GS562 ♂ 12-12-45 Saiat (Kaira Dist.); GS580 ♀ 15-12-45, GS638 ♂ 18-12-45, GS668 ♀ 20-12-45 Vaghjipur (Mehsana Dist.); GS947 ♀ 20-1-46 Balaram (Palanpur); GS1122 ♂ 27-3-46 Juna Rajpipla.

Elsewhere noted: Kutch: Bhuj environs; Mandvi. Saurashtra: Dwarka. Gujarat: Cambay; Radhanpur; Kharaghoda, etc.

Measurements:	W	B	Tar.	T
5 ♂♂	69–72	42–46	8–10·5	30–33
3 ♀♀	69–71	43·5–44·5	9·5–10	30·5–34

The specimen from Dhari (No. B48), just completing general moult, is very blue and would pass for *taprobana*; but relatively more blueness or greenness seems to me a variable and unreliable subspecific character. Several others of the Gujarat series are equally blue with B48.

Occasional solos at ditches, ponds and streams. Not common. Breeds in Kutch, according to Lester, March to May. Gonads of all the above specimens were quiescent.

Pelargopsis capensis gurial (Pearson). The Brownheaded Storkbilled Kingfisher.

Specimens collected: Gujarat: GS946 ♂ 20-1-46 Balaram (Palanpur); GS1121 ♂+ 27-3-46 Juna Rajpipla; GS1147 ♂ 29-3-46, GS1163 ♀ 30-3-46, GS1195 ♀ 3-4-46 Dediapada (Rajpipla); GS1250 ♂+ 12-4-46, GS1263 ♀ 14-4-46 Waghai (Surat Dangs); SD372 ♂+ 19-3-48 Kalibel; SD435 ♂+ 24-3-48 Sakalpatal (Surat Dangs).

Absent in Kutch. Saurashtra?

Measurements:	W	B	Tar.	T
6 ♂♂	155·5–163	84–93	19–20	98–110
3 ♀♀	159–168	86–90	19–20	100–105

Not uncommon on forest streams. Its presence is usually advertised by its loud, explosive, harsh laugh *Kĕ-ke-ke-ke-ke* (accent on the initial *ke*), or the pleasant soliloquy *peer-peer--pūr* etc. Late March specimens were completing moult and their gonads were maturing.

Halcyon smyrnensis smyrnensis (Linnaeus). The Whitebreasted Kingfisher

Specimens collected: Gujarat: GS112 ♀ 2-11-45 Ajwa (Baroda Dist.); GS176 ♂ 9-11-45 Bodeli (Baroda Dist.); GS302 ♂ 19-11-45, GS337 ♂ 20-11-45 Dabka (Baroda Dist); GS454 ♀ 2-12-45 Golana, Cambay; GS496 ♂ 6-12-45 Cambay town environs, GS607 ♂ 16-12-45 Vaghjipur (Mehsana Dist.), GS1184 ♂ 2-4-46 Dediapada (Rajpipla).

Elsewhere noted: Kutch: Chaduva; Mandvi; Lakhpat. Saurashtra: Amreli; Kodinar. Gujarat: Radhanpur; Palanpur; Kharaghoda, etc.

Measurements:	W	B	Tar.	T
6 ♂♂	(115) 121–125	60–67	16 (19)	76·5–82
2 ♀♀	122–123	65–66	16·5–17	81–87·5

I agree with Whistler's remarks (*JBNHS*, 37; 762 and *Spolia Zeylanica* 23 (3 & 4): 228—Aug. 25, 1944) that Travancore and Ceylon birds are alike and there is no constant difference in colour between birds from the rest of India and the NW. race *smyrnensis* excepting a slight increase in size as one moves northward, in keeping with Bergmann's Rule.

A common and widely distributed species, but nowhere abundant. It is much less dependent upon the presence of water than other kingfishers, and is often met with in openly wooded country far away from any ponds or streams. The Survey specimens provide no indication of the breeding season in this area.

Halcyon pileata (Boddaert). The Blackcapped Kingfisher

Specimen collected: Gujarat: SD436 ♂ 24-3-48 Sakalpatal (Surat Dangs). Elsewhere not noted.

Measurements:	W	B	Tar.	T
1 ♂	130	64	15·5	81·5

The only example met with by the Survey. A solitary on a rock pool in Ambika River. In flight the large white patch in the wing is conspicuous and strikes immediate attention.

Family MEROPIDAE: Bee-eaters

Merops superciliosus persicus Pallas. The Bluecheeked Bee-eater

Specimens collected: Kutch: KS290 ♂, KS291 ♀ 30-9-43 Chaduva (Bhuj Dist.); Gujarat: GS1 ♀, GS2 ♂, GS3 ♂, GS4 ♂ 28-10-45, GS16 ♂, GS 17 ♀ 29-10-45 Ajwa (Baroda Dist.).

Elsewhere noted: Kutch: Rapar (21 Sept.), Bhuj (28 Sept.), Khavda (1 Oct.) Nir (5 Oct.) Absent at Chaduva (5 March). Saurashtra: Mithapur (Okhamandal, 23 Oct.), Amreli (17–20 Oct.).

Measurements.	W	B	Tar.	O.T	C.T
5 ♂♂	146–155	47–50	14–27	88–91	96–
3 ♀♀	142–150	16–47	14–46	85–92	97(1)

Evidently an autumn passage migrant over Kutch to its winter quarters in Africa, like the Kashmir Roller. First met September 21 (Rapar); abundant in 1st week of November. Between 5 March and 5 April no return passage was observed. In Gujarat its status is not clear, although to some extent it is certainly a passage migrant as in Kutch. In Saurashtra, K. S. Dharmakumarsinhji recently reported it as arriving in May and breeding in considerable numbers between June and August in the Bhavnagar area. (*JBNHS*, 46 : 723).

Affects the neighbourhood of tanks and jheels. The calls *te-tew* ? (repeated) heard in the distance are reminiscent of the *pettigrew* notes of the Redvented Bulbul.

Merops orientalis orientalis Latham. The Little Green Bee-eater

Specimens collected: Kutch: KS277 ♂ 26-9-1943 Bhuj environs; KS323 o ? 5-10-43 Nir (Pachham Island); Gujarat: GS157 ♂, 7-11-45, GS221 ♀, GS222 ♀ 11-11-45 Bodeli (Baroda Dist.); GS421 ♀, GS422 ♂ 29-11-45 Cambay town environs; GS991 ♂ 15-11-46 Dalkhania (Amreli Dist.); GS1055 ♂+ 20-3-46. Kharaghoda.

Measurements:	W	B	Tar.	O.T.	C.T.
5 ♂♂	94–97	28–33	10	70·5–73	121–141
1 ♀	94	32	10	72·5	126

Rare in Surat Dangs. Sparsely but generally distributed elsewhere in Gujarat, Saurashtra and Kutch. The Great Rann evidently acts as a barrier between *orientalis* and the paler race *biludschicus* of Sind, though individuals from Kutch and N. Gujarat may pass with either. Breeding seemed imminent by about mid March.

Nyctiornis athertoni athertoni (Jard. and Selby). The Bluebearded Bee-eater

No specimens obtained nor completely satisfactory sight record, but at Medha near Songadh (Navsari Dist., Gujarat) the distinctive guttural *korr-r-r* was heard in foothills moist deciduous forest country—the typical biotope of this species (8-4-1946). Confirmation is desirable.

Family CORACIIDAE : Rollers or Blue Jays

Coracias garrula semenowi Loudon & Tschusi. The Kashmir Roller

Specimens collected: Kutch: KS71 ♂ 17-8-43, KS98 ♀ 20-8-43 Chaduva (Bhuj Dist.); Gujarat: GS37 ♀ 30-10-45, GS88 ♂ 1-11-45 Ajwa (Baroda Dist.).

Elsewhere noted: Kutch: Anjar; Rapar; Bhachau; Khavda; Nir (Pachham Island). Saurashtra: Dwarka; Okha; Amreli; Dhari.

Measurements:	W	B	Tar.	T
2 ♂♂	197–205	35–37·5	25	124–128
2 ♀♀	190–201	36–39	24	121–130

A passage migrant in autumn, through Kutch and Saurashtra. Earliest date 17 August. Abundant between second week and end of September; mostly gone by end of October. The specimens of 30 October and 1 November were excessively fat in preparation for emigration to their winter quarters, presumably in Africa. Return migration to Kashmir, Baluchistan, etc., evidently takes place by a different route in spring. This species migrates during daytime, chiefly in the morning up till forenoon, but also throughout the day. The birds do not travel in flocks but rather like birds of prey, in a steady stream of spaced singles with an interval of half to several minutes between each individual. On September 20 and 21 (1943, Rapar, Kutch) migration was observed in progress. The birds were flying steadily over a wide front, 300 to 400 ft. up, in an ENE.-WSW. direction. The wing beats are slow and deliberate, like a crow's, and in the distance the flight silhouette is also very reminiscent of that bird.

Coracias benghalensis benghalensis (Linn.). The Indian Roller

Specimens collected : Kutch: KS148 ♂ 3-9-43 Nakhatrana. Gujarat: GS152 ♂, GS153 ♀, GS154 ♂ 7-11-45 Bodeli (Baroda Dist.); GS472 ♀ 3-12-45 Golana, Cambay; GS538 ♀ 11-12-45 Nadiad town environs (Kaira Dist.); GS720 ♂ 26-12-45 Patan (Mehsana Dist.); GS1071 ♂+ 21-3-46 Kharaghoda; GS1234 ♂ 9-4-46 Songadh (Navsari Dist.).

Measurements :	W	B	Tar.	T
5 ♂♂	185–193	39–44	25–28	122–134
3 ♀♀	189–190	40–44·5	26–29	126–134

Assigned to this northern race in accordance with the arbitrarily fixed boundary at 20° N. Lat. by Whistler (*JBNHS*, 37 : 755).

Commonly but sparsely distributed. Not abundant anywhere. Birds in tumbling aerobatic displays were observed between December and April. Breeding was in progress during March/April. Has a curious habit, while perched, of swinging its tail slowly up and down as in the Black-winged Kite, the Forest Wagtail and the Little Green Bee-eater.

Family UPUPIDAE : Hoopoes

Upupa epops epops Linnaeus. The Hoopoe

Specimens collected: Kutch: KS93 ♀ 19-8-43 Chaduva (Bhuj Dist.); KS125 ♂ 30-8-43 Bhuj environs; KS408 ♀24-3-44 Chobari (Bhachau Dist.). Saurashtra: B27 ♀ 17-10-43 Amreli. Gujarat: GS70 ♀, GS71 ♂, GS72 0? 1-10-45 Ajwa (Baroda Dist.); GS143 ♀ 6-11-45 Bodeli (Baroda Dist.); GS284 ♂ 18-11-45 Dabka (Baroda Dist.); GS543 ♂ 11-12-45 Nadiad environs (Kaira Dist.); GS740 ♂ 27-12-45 Patan (Mehsana Dist.); GS1062 ♂+ 20-3-46 Kharaghoda.

Elsewhere noted: Kutch; Nakhatrana, Anjar; Khavda (Pachham Island), Nir; Saurashtra: Kodinar; Dalkhania: Gujarat. Radhanpur; Deesa; Palanpur, etc.

Measurements :	W	B	Tar.	T
5 ♂♂	148–155	54–63	23·5–26	99–105
5 ♀♀	140–150	50–55	21–23	95–100

Specimen No. GS1062 was in freshly moulted plumage on 20 March and fat. The gonads were maturing, and the bird seemed getting ready to breed.

I agree with Whistler's doubts (*JBNHS*, 37 : 28) as to whether the race *orientalis* of north India is worth recognizing. There seem to be no tangible or constant characters by which it can be separated from typical *epops*. The above series from Gujarat include both darker and paler birds. They measure larger than *ceylonensis* and are also distinctly paler than that race, possessing white subterminal spots to the long hind feathers of the crest.

Not common, but frequent. Presumably resident, though the numbers may be augmented during the winter months by influx of immigrants from the north.

Usually seen singly, but on occasions loose parties of 10 or more were met with feeding on a restricted piece of ground.

Family BUCEROTIDAE : Hornbills

Tockus birostris (Scopoli). The Grey Hornbill

Specimens collected : Gujarat: GS1089 ♂+, GS1090 ♂+ 25-3-46 Juna Rajpipla.

Elsewhere noted : Gujarat: Ajwa (Baroda Dist.); Hathidhara (Palanpur); Songadh (Navsari Dist.); Galkund, Malegaon, etc., (Surat Dangs).

Absent in Kutch.

Measurements :	W	B	Tar.	T
2 ♂♂	220	106–112	45–47	266–276

Not uncommon in the better wooded parts of Gujarat with a generous sprinkling of large banyan and peepal trees (*Ficus bengalensis* and *F. religiosa*). Local name : Chalotra. There is a widespread belief in its medicinal properties as a cure for after-childbirth pains in women, and the birds are persecuted to some extent on this account. A broth is prepared of the entire bird, feathers and all, which is taken internally. In addition a decoction of it is used for bathing.

Both birds had testes enlarged to breeding size and from the paucity of females at this period it is possible that they may be sitting on eggs.

Family CAPITONIDAE : Barbets

Megalaima zeylanicus inornata Walden. The Large Green Barbet

Specimens collected : Gujarat: GS960 ♂, GS961 ♂ 20-1-1946 Hathidhara (Palanpur); GS1093 ♂+ 25-3-46 Juna Rajpipla; GS1210 ♂+ 7-4-46 Songadh (Navsari Dist.); SD48 ♀ 27-2-48, SD68 ♂ + 28-2-48 Malegaon; SD121 ♂+ 2-3-48 Galkund; SD241 ♂ + 10-3-48, Laochali; SD338 ♀ 16-3-48, SD356 ♂+ 18-3-48 Mheskatri; SD394 ♂+ 20-3-48 Sarwar (Surat Dangs).

Elsewhere noted : Gujarat : Pavagadh (Panchmahals Dist.).

Measurements :	W	B	Tar.	T
9 ♂♂	119–127	34·5–38·5	30–32·5	72–78·5
2 ♀♀	119–123	40–41	30–33	73–74

This race is very brown above and below with practically no streaking on the breast; or rather the streaks are much finer and less contrasty than in *zeylanicus.* The brown of the head and breast, moreover, is silky and very buff if viewed from the side. In *zeylanicus* the head and breast are almost umber brown with the whitish streaks standing out boldly.

Restricted to well wooded country; abundant and noisy where occurring. Feeds chiefly on banyan and peepal figs. Occasionally sips nectar from *Erythrina* flowers. Call : a loud *kutroo, kutroo, kutroo,* or *pocock, pocock, pocock,* repeated *ad nauseam.* Breeding was in progress during March.

Megalaima viridis (Boddaert). The Small Green Barbet

Specimens collected: Gujarat: SD81 ♀ 29-2-1948 Malegaon (Surat Dangs). Only observed in the Surat Dangs, not elsewhere in Gujarat. Absent in Saurashtra and Kutch.

Measurements:	W	B	Tar.	T
1 ♀	107	29	27	66

Restricted to moist deciduous forest in Ghats foothills country, and here not uncommon. Call: *kutroo*, *kutroo*, etc., rather like the Large Green Barbet's but in a higher key and distinguishable if heard side by side, e.g., at Malegaon.

Megalaima haemacephala indica (Latham). The Crimsonbreasted Barbet

Specimens collected: Saurashtra: B25 ♂ 17-10-43 Amreli; Gujarat: GS38 ♀ 30-10-43 Ajwa (Baroda Dist.); GS208 o ? 10-11-43 Bodeli (Baroda Dist.); GS376 ♂+, GS377 ♀+ 23-11-43 Dabka (Baroda Dist.); GS424 ♀ 29-11-43 Cambay town environs; GS918 ♂+ 14-1-46 Deesa (Palanpur); GS1197 ♀+ 3-4-46 Dediapada (Rajpipla); SD18 ♂+ 24-2-48 Malegaon; SD393 ♂+ 20-3-48 Sarwar (Surat Dangs).

Rare in Kutch.

Measurements:	W	B	Tar.	T
5 ♂♂	78–81	16–19·5	17–21	34–36
4 ♀♀	75–81·5	17–19	18–20·5	30–35

In abraided plumage back looks more bluish grey-green, less yellowish green as in fresh plumage. This difference has no racial significance since both types are found in the same localities seasonally. Feathers of the back become abraided in nesting birds presumably due to the constant scraping in and out of nest-holes. Therefore I cannot uphold Koelz's race *confusa* from Londa, described in *Proc. Biol. Soc., Washington*, 52: 78—1939.

Common. Nesting in progress November/December—March/April.

Family PICIDAE: Woodpeckers

Iynx torquilla ssp. The Wryneck

Specimens collected: Kutch: KS374 ♀ 15-3-44 Jakhau; KS124 ♀ 29-8-43, KS184 ♀ 8-9-43, KS275 o? 26-9-43 Bhuj environs; KS292 ♀ 30-9-43 Chaduva (Bhuj Dist.); Gujarat: GS39 ♂ 30-10-45, GS79 ♂, GS80 ♀ 1-11-45, GS115 ♀ 3-11-45 Ajwa (Baroda Dist.); GS351 ♂ 21-11-45 Dabka (Baroda Dist.); GS667 ♀ 20-12-45 Vaghjipur (Mehsana Dist.); GS708 ♀ 25-12-45 Patan (Mehsana Dist.); GS898 ♂ 12-1-46 Deesa (Palanpur); GS1111 ♀ 26-3-46 Rajpipla environs. Saurashtra: B36 ♂ 18-10-43 Amreli.

Measurements:	W	B	Tar.	T
4 ♂♂	87–92	16–18	20–22	65·5–70·5
7 ♀♀	86–92	14–17	18–21	65–70

I can see little constant difference in winter between the typical European race and the Asiatic form *chinensis* which breeds in Kashmir, and therefore hesitate to assign my specimens to either.

Fairly common winter visitor. Earliest date 29 August (Kutch); latest 1 April (Rajpipla). Hops along ground like finch to pick up food: ants and other insects and seeds (?). Clings to thin stems of trees like woodpecker and also perches across branches like a passerine bird. Flight often deceptively finchlike. On a fleeting glimpse, when dashing from one thicket to another, easily mistaken for Great Reed Warbler (*Acrocephalus stentoreus*) in appropriate facies. Utters a harsh quick-repeated nasal *chewn, chewn, chewn, chewn,* at about 3 per second, of timbre between call of Myna and Goldenbacked Woodpecker's 'laugh'.

Affects dry scrub jungle and semidesert country with *Prosopis*, *Euphorbia*, etc.

Micropternus brachyurus jerdoni (Malherbe). The Rufous Woodpecker

Specimens collected: Gujarat: SD421 ♀, SD422 ♂ 22-3-1948 Pimpri (Surat Dangs).

Elsewhere not noted.

Measurements:	W	B	Tar.	T
1 ♂	131	30	24	62
1 ♀	129	30	24	64·5

Both these specimens have crown and nape grey, contrasting clearly with the rufous of rest of upper parts. The dark chocolate and whitish squamation on the chin and throat is more pronounced in the female. In the male this is obsolete and also lacks the chocolate. A cline in size from Travancore birds is noticeable (4 ♂♂ W 116·5–120·5; 4 ♀♀ 116·5–123). A female from Andheri (Greater Bombay) in the B.N.H.S. collection has W 125·5 mm.

The above were the only 2 examples met with by the Survey. They were busy digging a hole, about 2½ inches in diameter, in a carton nest of black tree ants in secondary deciduous jungle. Gonads undeveloped.

Picus chlorolophus chlorigaster Jerdon. The S. Indian Small Yellow-naped Woodpecker

Specimens collected: Gujarat: GS1199 ♂ 7-4-1946, GS1225 ♀, GS1226 ♂ 9-4-46 Songadh (Navsari Dist.); SD19 ♂+ 25-2-48 Malegaon; SD38 ♀ 26-2-48 Galkund; SD419 ♂+ 22-3-48 Pimpri (Surat Dangs).

Measurements:	W	B	Tar.	T
4 ♂♂	123·5–128	27–30	22–24	78–85
2♀♀	124–125	29–30	22–23	77–81

Not uncommon in hilly bamboo, teak and mixed moist deciduous forest. Utters a single nasal, rather mournful note *cheenk,* about one second long, from the top twigs of a leafless tree. Breeding March/April.

Dinopium benghalense benghalense (Linn.). The Goldenbacked Woodpecker

Specimens collected: Gujarat: GS206 ♂, GS207 ♀ 10-11-1945 Bodeli (Baroda Dist.); GS418 ♀ 29-11-45 Cambay town environs; GS707 ♂ 25-12-45 Patan (Mehsana Dist.); GS841 ♀ 6-1-46 Radhanpur; GS875 ♀+ 11-1-46 Deesa (Palanpur); GS948 ♂+ 20-1-46 Balaram (Palanpur); GS1098 ♀+, GS1099 ♂+ 25-3-46 Juna Rajpipla; GS1156 ♂ 30-3-46 Dediapada (Rajpipla); SD35 ♂, SD36 ♀ 26-2-48 Galkund; SD175 ♂

6-3-48, SD210 ♂+ 7-3-48 Pandwa; SD248 ♀+ 10-3-48, SD281 ♂+ 12-3-48 Laochali; SD323 ♀ 16-3-48 Mheskatri. (SD series from Surat Dangs).

Elsewhere noted: Saurashtra: Bhavnagar (2 specimens: K. S. Dharmakumarsinhji). Not met with in Kutch though Hume implies its occurrence there (*S.F.*, 3 : 459).

Measurements:	W	B	Tar.	T
9 ♂♂	136·5–150	37–43·5	24-28	78–95
8 ♀♀	136–152	37·5–42	24·5–28	83–94

Birds from Palanpur and Radhanpur—both in northern Gujarat near the Rajasthan boundary—show no obvious passage to *dilutum* in coloration. The latter is the race with paler yellow upper parts occurring in Sind, and also recorded from Mt. Abu. Specimens from Jodhpur 'definitely belong to the typical form' (Whistler *JBNHS*, 40: 225).

Not uncommon in the better wooded tracts of the area. Breeding January to March/April. Together with *Chrysocolaptes lucidus* frequently observed taking deep draughts of nectar from blossoms of *Erythrina stricta*.

Dryocopus javensis hodgsoni (Jerdon). The Great Black Woodpecker

Specimens collected: Gujarat: GS1214 ♂ 8-4-46 Songadh (Navsari Dist.); GS1296 ♀, GS1297 ♂, GS1298 ♂ 19-4-46 Galkund (Surat Dangs); SD225 ♂ 9-3-48, Piplaidevi; SD226 ♀ 9-3-48 Ahwa; SD234 ♀, SD235 ♂ 10-3-48, SD261 ♂, SD262 ♀, SD263 ♀ 11-3-48 Laochali; SD341 ♀ imm., SD342 ♀ 16-3-48 Mheskatri (Surat Dangs).

Not noted elsewhere in Gujarat, or in Saurashtra or Kutch.

Measurements:	W	B	Tar.	T
6 ♂♂	213–225	63–69	37–43	147–165
6 ♀♀	214–219	56–65	36–39	122–161

Iris in adult (both sexes) yelllowish white; in immature pearl grey. The young female (SD341) in addition to the crimson patch on the hindcrown, as in the adult female, has the forecrown sparsely stippled with crimson.

All the specimens were in more or less heavy general moult in March/April. Their gonads were quiescent, but from the immature collected on 16 March it would appear that the breeding season is towards the end of the year?

Stomachs examined were crammed with pupae (? termites), about 10 × 2 mm. each, over 500 being taken from three specimens. A fourth stomach contained large grubs of boring beetles and ant pupae 4 × 2 mm.

The female also calls *chiank* like the male. The flight is stately with unhurried deliberate wing beats, rather reminiscent of a crow in silhouette.

Songadh in Navsari Dist. is now established as the northernmost point in the distribution of this woodpecker along the Western Ghats. Affects moist deciduous, forest in hummocky foothills country, synecologically with *Hemicircus* and *Chrysocolaptes lucidus*. The birds are greatly persecuted by the Dangi Bhils for the 'squabs' which are claimed to be an epicurean delicacy!

Picoides mahrattensis mahrattensis (Latham). The Yellowfronted Pied Woodpecker

Specimens collected : Kutch: KS35 ♂, KS36 ♀ 11-8-43 Bhuj. Gujarat: GS311 ♀ 19-11-45, GS343 ♂, GS344 ♂ 21-11-43, GS371 ♂ 22-11-43 Dabka (Baroda Dist.); GS419 ♂, GS420 ♀ 29-11-45 Cambay town environs; GS666 ♂ 20-12-45, GS681 ♀ 21-11-45 Vaghjipur (Mehsana Dist.); GS827 ♀ 4-1-46 Radhanpur; GS853 ♂ 9-1-46 Deesa (Palanpur); GS949 ♂ 20-1-46 Balaram (Palanpur); GS1144 ♂+, GS1152 ♂+ 29-3-46 Dediapada (Rajpipla); SD119 ♀ 2-3-48, SD136 ♂+ 3-3-48 Galkund: SD259 ♂+ 11-3-48 Laochali (Surat Dangs).

Elsewhere noted : Saurashtra: Kodinar; Dalkhania (Amreli Dist.)

Measurements :	W	B	Tar.	T
12 ♂♂	(96) 100–104 (107)	25–27·5	16–20·5	(50) 57–64
6 ♀♀	(94) 100-103	23–25	18–19	57–61

All the specimens are typical *mahrattensis* except GS827 (Radhanpur) and GS949 (Balaram, Palanpur) which, in their slightly more extensive white of the upper parts suggest intergrading with *aurocristatus*. On the whole these two specimens match two examples from Jodhpur in the B.N.H.S. collection determined as *aurocristatus* by Whistler (*JBNHS*, 40 : 226) but which themselves seem intermediate (see Whistler's remarks, Eastern Ghats Survey, *JBNHS*, 37 : 228). Kutch birds appear to go better with the typical race.

Affects the more dry scrub jungle with babul and *Prosopis* trees. Also roadside *Dalbergias*, and mango groves near villages etc. Was seen in Kutch clinging to dry *Euphorbia* stems in arid, stony, hummocky country. Breeding was in progress in March/April. From time to time during this season the male (only ?) drums *dr-r-r-r-r-r* continuously for 1–2 seconds.

The call-note commonly heard, at other seasons also, is a sharp *click-click* or *click-r-r-r*.

Picoides nanus hardwickii (Jerdon). The Pigmy Woodpecker

Specimens collected: Gujarat: GS213 ♀, GS214 ♂, GS215 ♂, GS216 ♀ 10-11-45, GS227 ♂, GS228 ♀, GS229 ♂, 11-11-45 Jambughoda; GS1145 ♂ 29-3-46, GS1159 ♂ 30-3-46 Dediapada (Rajpipla); GS1295 ♂ 19-4-46 Galkund (Surat Dangs); SD2 ♂ 23-2-48 Malegaon; SD118 ♀ 2-3-48, SD135 ♂ 3-3-48 Galkund; SD246 ♀ 10-3-48 Laochali; SD347 ♀ 17-3-48 Mheskatri; SD404 ♀+ 20-3-48 Sarwar; SD460 ♀ 25-3-48 Chikhli (SD = Surat Dangs).

I have seen two specimens collected in Bhavnagar, Saurashtra, by K. S. Dharmakumarsinhji. Absent in Kutch.

Measurements :	W	B	Tar.	T
9 ♂♂	72–75	14–15·5	12–14·5 (16)	31·5–38
8 ♀♀	73–76(79)	13·5–16	13–15	32–37·5

Common. Breeding March/April. An example was observed roosting at night in a crotch of upright branches about 14 ft. up in a leafless tree in bare deciduous pole forest. The bird clung at an angle of about 45°. It was not observed in the same place the following night.

Hemicircus canente canente (Lesson). The Heartspotted Woodpecker

Specimens collected : Gujarat: GS1200 ♀, GS1201 ♂ 7-4-46 Songadh (Navsari Dist.); GS1248 ♂ 12-4-46 Waghai (Surat Dangs); SD304 ♀, SD305 ♂ 14-3-48 Mahal; SD373 ♂, SD374 ♀ 19-3-48, SD397 ♂, SD398 ♀ 20-3-48 Sarwar (Surat Dangs).

Not recorded in Saurashtra. Absent in Kutch.

Measurements :	W	B	Tar.	T
5 ♂♂	93–99	20–22·5	18·5–19·5	33–35
4 ♀♀	92–94	19·5–21	17·5–18·5	32·5–34·5

For my reasons for not recognising the race *H. c. cordatus* see *JBNHS,* 49 : 786. Songadh in Navsari District now becomes the most northerly point of the distribution of this woodpecker in the Sahyadris or Western Ghats. In view of its discovery in this area, the doubt cast in F.B.I. (iv : 85) on Jerdon's record from the adjacent Madhya Pradesh is nullified.[1]

Not uncommon in the moister facies of deciduous forest—in hilly bamboo, teak and mixed jungle. Its large crested head, attenuated neck and the curious broad, short rounded tail, together with its habit of perching crosswise on a bare top twig like a passerine bird, draws attention to it a long way off. Goes about in pairs. The gonads of the specimens furnished no indication of the breeding season.

Chrysocolaptes festivus festivus (Boddaert). The Blackbacked Woodpecker

Specimens collected : Gujarat: GS1173 ♀, GS1174 ♂ 31-3-46, GS1182 ♂ 2-4-46 Dediapada (Rajpipla); SD37 ♀ 26-2-48 Galkund; SD231 ♀ 10-3-48 Laochali; SD322 ♂ 16-3-48 Mheskatri; SD409 ♂ 21-3-48, SD420 ♀ 22-3-48 Pimpri (Surat Dangs).

Not noted elsewhere in Gujarat, or in Saurashtra. Absent in Kutch.

Measurements :	W	B	Tar.	T
4 ♂♂	155–162	50–54	29·5–31	72–80
4 ♀♀	150–158	43·5–51	26–30	72–87

Specimen SD37 marked ♀ has a paler brown back and its crest and crown feathers are tipped with scarlet. (Immature ♂ ?)

This species has the habit of chiselling out several holes in the trunk of a tree one below the other in 'apartment house' fashion. What the facts of their ownership are is not clear, i.e., whether they belong to one bird or are colonial, but in one instance four of such holes a few feet apart vertically, were occupied as nightly roost by one bird each on two successive evenings, and 3 similar holes in a nearby trunk by 3 more birds. A male shot whilst busily chiselling out the topmost hole of a series of 4, on dissection, showed no gonadal development. All specimens collected in March and April were in various stages of general moult involving body, rectrices and remiges. Their gonads provided no indication of breeding.

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[1] The ornithological surveys of Bastar (eastern Madhya Pradesh) in 1948, and Orissa hills in 1949, actually procured several specimens in those areas.

Chrysocolaptes lucidus chersonesus Kloss. Malherbe's Golden-backed Woodpecker

Specimens collected: Gujarat: GS1281 ♂ 17-4-46 Mahal (Surat Dangs); SD44 ♂, SD45 ♂, SD46 ♀ 27-2-48 Malegaon; SD91 ♂+ 29-2-48 Pimpri (Surat Dangs).

Elsewhere not noted.

Measurements:	W	B	Tar.	T
4 ♂♂	149–158	43–46	29·5–30	80–91
1 ♀	154	43	30	85

Iris ♂♀ pale fawn or biscuit colour.

The above specimens provide a northward extension into the Khandesh area of this species and race. Stuart Baker (Fauna iv : 81) gives its range as 'India south of Bombay City and the Province of Orissa'.

Not common. Confined to moist deciduous biotope. Breeding in February, on.

Family Pittidae : Pittas

Pitta brachyura [**brachyura** (Linn.)]. The Indian Pitta

Not seen or heard by the Survey between August and mid April, in Kutch, Saurashtra or Gujarat. Possibly arrives in suitable localities, as elsewhere, as forerunner of the SW. monsoon at the end of May or in early June. K. S. Dharmakumarsinhji found it 'widespread and calling frequently' in the Gir forest, Junagadh, in the last week of May (1947). One pair had started to nest. (*JBNHS*, 48 : 189).

Family Alaudidae : Larks

Mirafra javanica cantillans Blyth. The Singing Bush Lark

Specimens collected: Kutch: KS104 ♂+, KS105 ♂+ 21-8-1943 Chaduva (Bhuj Dist.); KS157 ♂+ 4-9-43 Nakhatrana. Gujarat: GS530 ♀ 9-12-45 Nadiad environs (Kaira Dist.).

Measurements:	W	B	Tar.	T
3 ♂♂	75–81	13–14	...	49–55
1 ♀	80	13·5	22	51

In very worn plumage in August/September; freshly moulted in December/January. In fresh post nuptial dress the white chin and throat are prominent; the pale edged dark brown feathers of the back are reminiscent of juvenile *Galerida* larks.

A not uncommon resident species doubtless often confused with the Skylark when soaring aloft and singing, as I myself did until specimens were actually secured of birds that had dropped to earth after the performance. Except that the singer does not, *perhaps*, ascend as high in the air as the Skylark, I could detect no consistent difference in the song or the song-flight of these two species, as also those of Sykes's Crested Lark (*Galerida deva*). My impression is, however, that the Singing Bush Lark and Sykes's both incorporate in their song the calls of other birds far more freely than the Skylark does. Amongst these I have heard perfect imitations of Common Babbler, Tailor Bird, Franklin's Wren-Warbler, Rufousfronted Wren-Warbler, Jungle Wren-Warbler, Wood Shrike, Redwinged Bush Lark, Purple Sunbird and Rain Quail. The imitations run into one another in quick succession with no break in the melody.

Breeding was in progress in Kutch during August.

Mirafra erythroptera sindiana Ticehurst. The Redwinged Bush Lark

Specimens collected: Kutch: KS17 ♂+ 9-8-1943 Bhujia Fort; KS82 ♂+ 18-8-43 Chaduva (Bhuj Dist.); KS287 ♀ 28-9-43 Bhuj environs; KS383 ♂ 17-3-44 Mata-no-Madh; KS416 ♂ 28-4-44 Bela Island (Great Rann). Gujarat: GS26 ♂ 29-10-45 Ajwa (Baroda Dist.); GS 274 ♂ 17-11-45 Dabka (Baroda Dist.); GS665 ♂ 20-12-45, GS679 ♂ 21-12-45, Vaghjipur (Mehsana Dist.); GS715 ♀, GS716 ♂ 25-12-45, GS 727 ♂ 26-12-45, Patan (Mehsana Dist.); GS756 ♂ 30-12-45 Radhanpur; GS851 ♂ 9-1-46 Deesa (Palanpur); GS1002 ♂, GS1003 ♂ 15-3-46 Dalkhania (Amreli Dist.).

Measurements:	W	B	Tar.	T
13 ♂♂	(73, 75) 77–84	12·5–15	20·5–23	46–56
2 ♀♀	73·5–76	13–14·5	22–22·5	44·5–47

Specimens GS26 and GS274 from Baroda District have rufous-tinged edging to feathers of back and would pass for typical *erythroptera*. So are also GS1002–GS1003 from south Saurashtra nearer the typical race. Specimens from Kutch and Gujarat north of Baroda, as a series, seem nearer *sindiana* though it is clear that most birds are intermediate. No. GS679 has the 2nd and 3rd primaries wholly rufous—up to their tips, with only a faint brown spot near extreme tip.

Common in stony scrub country, singly or in loose parties of 3 to 5. In the breeding season, June to September, the parachuting display and song of the male described in my 'Birds of Kutch' (p. 60), is diagnostic of the species. In the appropriate biotope one can hardly go far in any direction without seeing one or more males thus advertising themselves.

Eremopterix grisea Scopoli. The Blackbellied Finch Lark.

Specimens collected: Gujarat: GS13 ♂ 28-10-45 Ajwa (Baroda Dist.); GS313 ♂+, GS314 ♀+ 19-11-45 Dabka (Baroda Dist.); GS725 ♀, GS726 o? juv. 26-12-45, GS744 ♂ 27-12-45 Patan (Mehsana Dist.); GS790 ♂, GS791 ♀ Radhanpur; GS1033 ♂ juv. 19-3-46 Kharaghoda. Kutch: KS83 ♂+, KS84 ♀+ 18-8-43 Chaduva (Bhuj Dist.).

Measurements:	W	B	Tar.	T
7 ♂♂	74–80	11–12·5	16–17	41–45
3 ♀♀	73–78	10·5–11	16	38–42

The males, as a series, are a trifle greyer above seen with 'the eye of faith' though one would expect Radhanpur birds to be definitely so, being nextdoors to Deesa, the type-locality of *siccata* Ticehurst. I agree with Dr. Dillon Ripley's action (Checklist MS) in sinking this very poorly differentiated race.

Resident, common, but like the Rufoustailed Finch Lark subject to considerable seasonal local movement. There is apparently no hard and fast breeding season. Odd birds were breeding from August to April.

Ammomanes phoenicurus phoenicurus (Franklin). The Rufous-tailed Finch Lark.

Specimens collected: Kutch: KS41 ♂, KS42 ♀ 11-8-43 Padhar (Bhuj Dist.); KS65 ♂ 16-8-43 Chaduva (Bhuj Dist.); Gujarat: GS164♂, GS165 ♂ 8-11-45 Bodeli (Baroda Dist.); GS781♀ 31-12-45 Radhanpur; SD282 ♂+, SD283 ♀ 12-3-48 Laochali (Surat Dangs). Saurashtra: GS996 ♂, GS997 ♀ 14-3-46 Dalkhania (Amreli Dist.).

Measurements:	W	B	Tar.	T
6 ♂♂	100–107	15–17	21·5–24	57–64
4 ♀♀	98·4–104	14·5–15·5	21·5–23	55–63

Resident. Breeding March/April. Affects dry stony country, ploughed fields etc. Marked local movement was noticeable in Kutch where, in suitable localities, it was far more plentiful in March than it had been in August/September.

Alaemon alaudipes doriae (Salvadori). The Hoopoe Lark or Large Desert Lark

Specimens collected: Kutch: KS295 ♂+ 1-10-1943 Khavda (Pachham Island); KS318 ♀+ 4-10-43, KS324 ♂+ 6-10-43 Nir (Great Rann); KS409 ♂ 25-3-44, KS410 ♀ 25-3-44 Chobari (Bhachau Dist.).

Elsewhere noted: Between Kakindia Bet and Gangli Bet; between Dholovira and Bela (Great Rann). Pung Bet (Little Rann).

Measurements:	W	B	Tar.	T
3 ♂♂	126–136	30·5–34·5	33·5–36	79–93
2 ♀♀	117–118	27	30·5–32	75

Affects salt-encrusted barren sandy 'pats' in the Rann, usually in pairs or singly. Some examples were seen as far away as 10 to 12 miles out on the Great Rann, on absolutely bare and featureless sunbaked terrain with not a stone or blade of grass to afford shelter from the fierce midday sun. Breeding was in progress in early October. The song and courtship display have been described in my 'Birds of Kutch' (p. 57.).

Calandrella cinerea longipennis (Eversmann). The Yarkand Short-toed Lark

Specimens collected: Kutch: KS192 ♂, KS193 ♂ 9-9-43 Bhuj environs; KS308 ♂, 309 ♀, KS310 ♀ 2-10-43 Khavda (Pachham Island); KS343 ♀, KS344 ♂, KS345 ♀, KS346 ♀ 8-3-44 Mandvi. Saurashtra: B13 ♀ 13-10-43 Dwarka. Gujarat; GS438 ♀, GS439 ♂ 30-11-45 Cambay town environs; GS623 ♀ 17-12-45 Vaghjipur (Mehsana Dist.); GS713 ♂, GS714 ♂ 25-12-45 Patan (Mehsana Dist.); GS792 ♂ 1-1-46 Radhanpur; GS848 ♀, GS849 ♂, GS862 ♀, GS863 ♂, GS864 ♀, GS865 ♂ 9-1-46 Deesa (Palanpur); GS1034 ♂ 19-3-46 Kharaghoda.

Measurements:	W	B	Tar.	T
9 ♂♂	95–100	12–15	20–21·5	54–64·5
11 ♀♀	88–94	12–14	20–21	53–56·5

Winter visitor. Common and abundant. Earliest date 9 September (Bhuj); latest 30 March. Affects semi-desert and open scraggy grass or weed-covered fallow land, usually in large flocks.

All the March specimens were excessively fat preparatory to emigration.

Calandrella raytal adamsi (Hume). The Indus Sand Lark

Specimens collected: Kutch: KS208 ♂+, KS209 ♂+, KS210 ♂+ 11-9-43 Kandla; KS370 ♂+ 15-3-44 Jakhau.

Not noted elsewhere, but K. S. Dharmakumarsinhji found a very distinct dark form of this lark inhabiting marine mud flats in Bhavnagar (Saurashtra) which Dr. C. Vaurie recently described as *C. r. krishnakumarsinhji* (*JBNHS*, 52: 8—1 July 1954).

Measurements:	W	B	Tar.	T
4 ♂♂	80–89	12–13·5	19–19·5	43–50

Resident. Not uncommon in the neighbourhood of salt pans and dry open sandy mudflats on the sea coast. Solos, or scattered twos and threes. Males soar about 100 ft. up to sing. The song is rather like that of Syke's Crested Lark, but short and broken: a few notes . . . pause . . . a few notes again . . . pause, and so on. Wanders here and there in the air while singing, and parachutes to earth in steps, with stiffly open wings and tail, hovering for a moment at each step in the descent. This performance is somewhat reminiscent of the song flight of the Indian Pipit. Also sings from perch on a mound. Lester gives the breeding season in Kutch as June and July, but all the specimens collected in September had enlarged gonads indicating that the season must extend through August, and later. In the March specimen also the testes appeared to be maturing (3×2 mm). In Bhavnagar, according to K. S. Dharmakumarsinhji, it breeds from March to September, principally between June and the latter month.

Galerida cristata chendoola (Franklin). Franklin's Crested Lark

Specimens collected: Kutch: KS108 ♂+ 24-8-43, KS117 ♂+ 27-8-43 Mandvi; KS211 ♀+ 12-9-43 Kandla. Saurashtra: B20 ♀ 13-10-43 Dwarka. Gujarat: GS784 ♂, GS785 ♀, GS786 ♂, GS787 ♀ 31-12-45 Radhanpur; GS1027 ♂, GS1028 ♀, GS1029 ♂, GS1030 ♂ juv. 19-3-46 Kharaghoda.

Measurements:	W	B	Tar.	T
6 ♂♂	98–105	20–23	23–26	54-62
5 ♀♀	92–98	19–22·5	23–27	51–55

Fairly common in the more arid portions of the area, in Kutch and N. Gujarat on the edge of the Great and Little Ranns. It affects open sandy sparsely scrubbed country, singly or in pairs and small parties. Breeding was in full swing in Kutch during August. No. GS1030 (19 March) was a juvenile just out of nest, with stub tail, wobbly flight and creamy yellow gape.

Galerida malabarica (Scopoli). The Malabar Crested Lark

Specimens collected: Gujarat: SD220 ♂+, SD221 ♂+ 7-3-1948 Fort Salher, 5000 ft. (Navsari Dist.).

Elsewhere not noted in Gujarat, Saurashtra or Kutch.

Measurements:	W	B	Tar.	T
2 ♂♂	97–98	16–17	23·5–24	53–57

Several pairs, evidently breeding, and one flock of about 15 observed on the grassy, stony, undulating plateau on the summit of Salher hill-fort. The call notes uttered on the ground and in low hovering flight are identical in pattern and quality with those of the Crested Lark (*Galerida cristata*).

Galerida deva (Sykes). Sykes's Crested Lark

Specimens collected: Kutch: KS63 ♂+ 13-8-43 Bhuj environs; KS72 ♀+ 17-8-43, KS80 ♀+, KS81 ♂+ 18-8-43 Chaduva (Bhuj Dist.); KS118 ♂+, KS119 ♂+ 27-8-43 Mandvi. Saurashtra: B21 ♂+, B22 ♀ 14-10-43 Dwarka; B33 ♂+ 18-10-43 Amreli. Gujarat: GS514 ♀, GS515 ♀ 8-12-45 Pariej (Kaira Dist.); GS560 ♂ 12-12-45 Saiat (Kaira Dist.); GS983 ♂, GS984 ♀, GS985 ♂ 12-3-46 Kodinar; GS1009 ♂ 15-3-46 Dalkhania (Amreli Dist.); GS1031 ♂, GS1032 ♀ 19-3-46 Kharaghoda.

Measurements:	W	B	Tar.	T
12 ♂♂	84–92	13–14·5	20–21·5	46–54
7 ♀♀	78–86	13–15	20–21·5	43–49·5

Common, resident. In non-breeding season, loose flocks of a dozen or so in open country, also dry grassy surroundings of tanks in Skylark-facies. Was breeding in August/September. Song and song-flight indistinguishable from those of the Singing Bush Lark and I was never able to be certain about the identity of an individual up in the air, and till it was shot on descent to the ground. The song contains imitations of most of the bird species associated with the lark in its habitat; curiously enough the presence of the Yelloweyed Babbler (*Chrysomma*) in a certain locality was first suggested to me by this lark's mimicry. The species was actually met with some time later!

In the Eastern Ghats Survey report [*JBNHS*, **37** (1): 104] Whistler moots the suggestion that *G. deva* might be treated as a race of *G. malabarica*. It seems to me that one very good reason why this is untenable is that in their habits, particularly in pattern of song and courtship display, these two larks are so markedly different. *G. malabarica* resembles *G. cristata* in general, whereas *G. deva* is almost identical with *Alauda gulgula* and *Mirafra j. cantillans*.

Alauda gulgula inconspicua Severtzoff. The Small Skylark

Specimens collected: Kutch: KS341 ♀, KS342 ♂ 8-3-44 Mandvi. Gujarat: GS561 ♂ 12-12-45 Saiat (Kaira Dist.).

Measurements:	W	B	Tar.	T
2 ♂♂	93–96	16–16·5	23–26	52–55
1 ♀	92	14·5	22·5	54

These birds differ from *A. g. gulgula* in being markedly paler and in possession of the other characteristics assigned to the race *punjaubi* by Whistler (*JBNHS*, 38: 767) now synonymized by Ripley (Checklist MS) as above.

Fairly common in suitable localities, on moist grassy margins of tanks etc. My impression is that the well-known song, uttered on the wing high up in the air, may usually be distinguished from the equally lively performance of Sykes's Crested Lark (*Galerida deva*) by its having fewer imitations of other bird calls, interwoven in it. Generally speaking, perhaps this species also sings from a loftier height than either Sykes's Crested Lark or the Singing Bush Lark.

(*To be continued*)

BIOLOGY AND ECOLOGY OF ORIENTAL TERMITES (ISOPTERA)

No. 1.—*ODONTOTERMES PARVIDENS* HOLMG. AND HOLMG. SEVERELY DAMAGING THE BARK AND CONTRIBUTING TO THE DEATH OF STANDING TEAK TREES IN UTTAR PRADESH, INDIA

BY

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(*With two tables and a plate*)

CONTENTS

PAGE

I. INTRODUCTION 459

II. OBSERVATIONS AND CONCLUSIONS 459

III. SUMMARY 461

IV. REFERENCES 462

I. INTRODUCTION

The termite, *Odontotermes parvidens* Holmgren & Holmgren, is a bark feeder and makes mud-plaster coverings on the trunks of trees; it does not make narrow, tubular mud-galleries like *Odontotermes obesus* (Rambur), the common mound-building termite. Beneath these mud-coverings the workers feed on the bark and sometimes even damage the sapwood of standing trees. *O. parvidens* does not build mounds but breeds in underground nests. It has been recorded as damaging the following timber species in India: *Duabanga sonneratioides* Ham., *Melanorrhoea glabra* Wall., *Pinus longifolia* Roxb., *Shorea robusta* Gaerten f. and *Sterculia villosa* Roxb. (Beeson, 1941, p. 552). It is also a serious pest of the roots of *Cajanus cajan* Linn. (Millsp.) (=*indicus* Spr.) (Rattanlal & Menon, 1953, pp. 83-84), and in my files I have a record of it on *Litsaea polyantha* Juss. in Assam. The present is the first record from teak, *Tectona grandis* Linn. f.

O. parvidens occurs practically all over India and goes up to an elevation of about 6,000 ft. above sea-level in the Himalayas.

II. OBSERVATIONS AND CONCLUSIONS

In May 1952, Dr. K. Kadambi, Assistant Central Silviculturist kindly informed me that teak (*Tectona grandis* Linn. f.) was dying in the Pharanda Range, Gorakhpur Forest Division, Uttar Pradesh, and that the bark showed signs of white-ant attack. Sometime later, specimens of damaged teak were received from the Range Officer, Pharanda Range. In January 1953 I visited the area and carried out examinations in the field.

The teak areas in the Pharanda Range are confined to the compartments and coupes in the West Lehra Forest Block, as given in Table I. Of these, teak in Compartment 10 (Coupe 16) and Compartment 11 (Coupe 3) showed the mortality described below. Both these coupes are *taungya* plantations, the age etc. of the trees being as given in Table 2.

TABLE I

Distribution, etc. of teak in the West Lehra Block, Pharanda Range, Gorakhpur Forest Division, Uttar Pradesh.

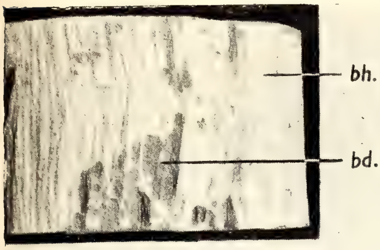
Coupe No.	Compartment No.	Acreage, etc. of forest
10	6	122 acres. (Teak 1 acre; remainder sal, *Shorea robusta*).
11	3	243 acres. (Teak 40 acres ; remainder sal.)
12	7	15 acres, all teak.
12	8	do.

TABLE 2

Height, age, etc. of some of the teak plantations mentioned in Table 1.

Compartment	Coupe	Age	Height	Diameter
10	16	17 years.	40–50 feet.	6–8 inch.
11	3	27 years.	60–80 feet.	8–12 inch.

According to the information supplied by the Range Officer, Pharanda Range, in April-May 1952 trees in these coupes (Table 2) started drying and the bark began to crack; this period coincided with the leafless condition (January-April), the new flush arriving at the end of May. The proportion of dead trees in May-June 1952 was roughly 30 per cent in Coupe 16 and 5 per cent in Coupe 3. After the first heavy rains in July 1952, there were no further deaths. The root stock in dried trees was noticed to be alive and sending out shoots in July 1952. This was so even at the time of my inspection in January 1953; other trees were completely dead, and the bark was largely or completely gone—dried up, cracked and peeled off. In 1952 the Range Officer noticed signs of heavy termite damage; and this was visible even in January 1953. The termites ate up the bark and bast; they thus exposed, dried and killed the cambium and produced a sort of 'girdling' effect. This injury as well as drought killed the trees. Dead termite soldiers and workers were collected beneath the mud plaster coverings on dead trees and proved to be *Odontotermes parvidens* Holmg. & Holmg.



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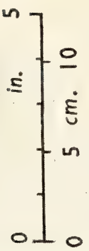

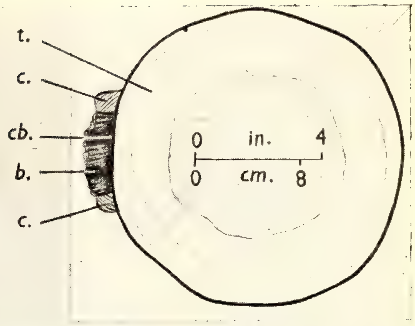

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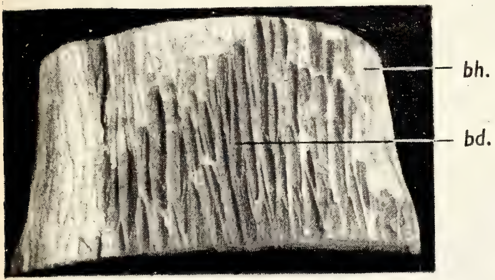

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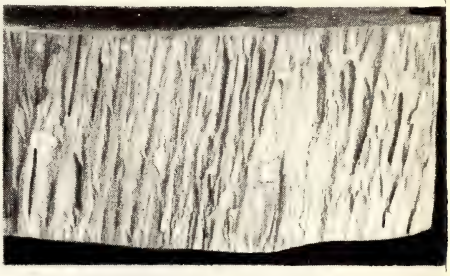

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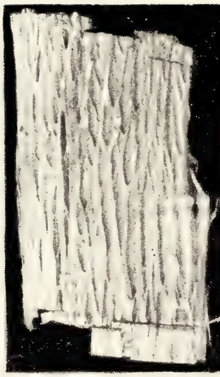

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Lettering.—*b*—bark; *bd*—portion of bark eaten up by termite; *bh*—portion of bark not eaten by termite; *c*—callosities; *cb*—cambium; *t*—trunk.

All figures are of portions of teak trees (*Tectona grandis* Linn. f.) from the West Lehra Block, Pharenda Range, Gorakhpur Forest Division, Uttar Pradesh, damaged by the termite *Odontotermes parvidens* Holmg. & Holmg., during 1951-52.

FIG. 1—Portion of trunk, showing light grazing (dark area, *bd*) on bark by the termite.

FIG. 2—Another portion of the same trunk, showing heavy damage to a portion of the bark (*bd*) by the termite. The rest of the bark is undamaged (*bh*).

FIG. 3—Another portion of the same trunk, showing even heavier damage to the bark by the termite than in fig. 2.

FIG. 4—Diagrammatic cross-section of the trunk of a tree whose entire bark was completely eaten up by the termite, except for a narrow strip (of bark and cambium) which sustained its life. (See text).

FIGS. 5-6—Outer views of portions of the bark, showing moderate damage by the termite.

FIG. 7—Inner view of a portion of the bark whose outer side was moderately damaged by the termite. Note that the inner side shows no damage.

FIGS. 8-10—Outer views of portions of the bark, showing severe damage by the termite.

In Coupe 3 it was seen in January 1953 that the mortality was most severe at the upper fringe of the slope where there was excessive drainage and little moisture retention in the soil. Towards the lower fringe, mortality was practically *nil*. In the adjoining Sample Plot of the same coupe, which was on flat ground, there was no mortality at all.

It appears that the trees were at least weakened, if they did not die, as a result of the severe drought in 1951 when only 22 inches of rainfall was received as compared to the normal of 55 inches per annum. That one single year's drought can be the sole or even the major contributing cause of death is a controversial question, especially owing to the high water-table in the Gorakhpur area, and the matter needs fuller investigation.

Whatever the cause of the initial weakening of these trees, it appears reasonable to assume that the severe damage to the bark by *Odontotermes parvidens* hastened their death. The process appears to have been somewhat as follows. The termites ate up all the bark and bast and thus exposed the cambium layer to the drying effect of the sun. The cambium being thus killed, there was a sort of 'girdling' effect and no nourishment was transported across the trunk. The tree, consequently, quickly dried up and died. This theory is well illustrated by the example of a tree of about 30-ft. height and 9-in. diameter at breast height, inspected in January 1953. This tree was alive at the time of my inspection, even though it was debarked completely naked by the termites, except for a very narrow strip (pl. 1, fig. 4) of bark (*b*) and cambium (*cb*) running from the ground level right up to the top of the bole; it was this narrow strip which was keeping the tree alive. The two sides of this strip had formed callosities (*c*).

As already mentioned, the termite lives under mud-plaster coverings on tree trunks. These mud-coverings reach up to the top of trees 40 or 50 ft. high. The bark is eaten in somewhat spindle-shaped grooves about 1-10 cm. long and 0.5-1 cm. wide. These grooves coalesce with one another, producing a complicated pattern (pl. 1, fig. 5). In cases of severe damage, the complete thickness of the bark is eaten away, but until the outer surface of the bark has been largely eaten up, the inner side is not touched and remains smooth (pl. 1, fig. 7). The healthy bark is fairly smooth and, in dried specimens, it is usually not more than about 4 mm. thick.

In addition to teak, this termite was also found commonly attacking the bark of sal trees (*Shorea robusta* Gaertn f.) in the same forest range. Nearly 50 percent of the sal trees showed the characteristic mud-coverings of *O. parvidens*. The bark, however, was much less severely damaged than in teak, and there were no deaths of sal in this area which could be attributed to the termite.

III. SUMMARY

1. The termite, *Odontotermes parvidens* Holmg. & Holmg., was noticed to damage severely the bark of standing teak trees (*Tectona grandis* Linn. f.) in the Pharanda Range, Gorakhpur Forest Division, Uttar Pradesh. This damage hastened the death of trees by exposing and killing the cambium and thus causing a 'girdling' effect.

2. The present is, I believe, the first record of this termite species damaging teak.

3. In addition, this termite was also found to damage the bark of sal (*Shorea robusta Gaertn. f.*).

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BIOLOGY AND ECOLOGY OF ORIENTAL TERMITES (ISOPTERA)

No. 2.—On Ecological Adjustment in Nature between two species of Termites, *COPTOTERMES HEIMI* (Wasm.) and *ODONTOTERMES REDEMANNI* (Wasm.)—in Madhya Pradesh, India

BY

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(*With 1 plate and 1 text-figure*)

Contents

		Page
I.	Observations	... 463
II.	Conclusions	... 466
III.	Summary	... 466
IV.	References	... 466

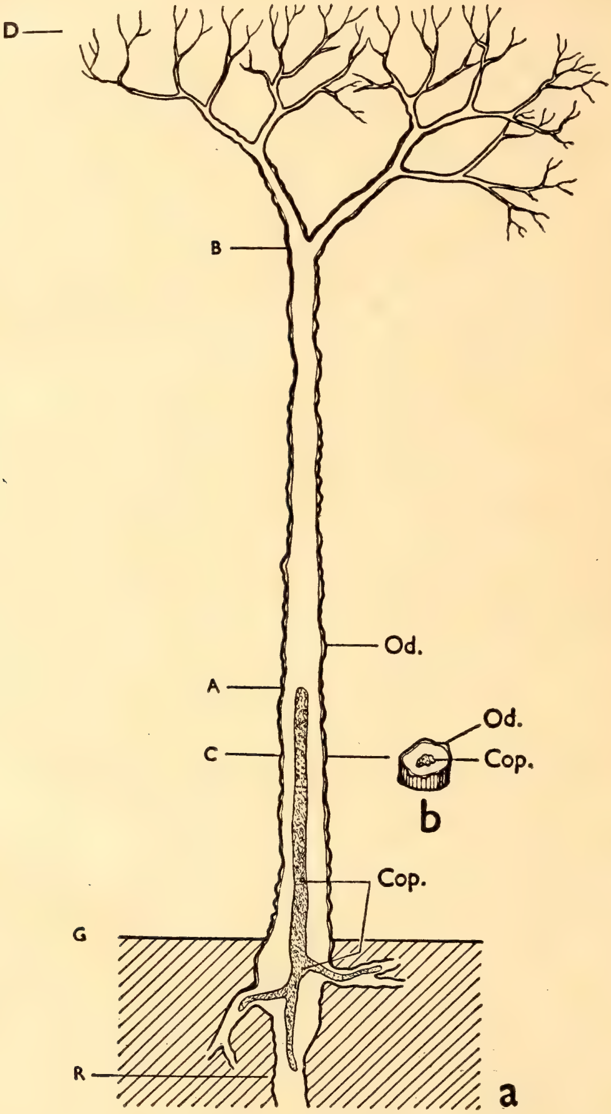
I. Observations

Recently I came across a vivid example of ecological adjustment in nature between two species of termites, namely the dry-wood species *Coptotermes heimi* (Wasmann) (family Rhinotermitidae, subfamily Coptotermitinae) and the mound-building and rotten-wood species *Odontotermes redemanni* (Wasmann) (family Termitidae, subfamily Macrotermitinae) which is worth recording, for such clear cut examples do not often come to light. The two species were competing for a recently dead, standing tree of salai (*Boswellia serrata* Roxb.—family Burseraceae) in the Sillari forest in Madhya Pradesh.

The Sillari forest lies about 41 miles north-east of Nagpur in Madhya Pradesh (formerly the Central Provinces) and belongs to the East Pench Forest Range of the Nagpur-Wardha Forest Division. The observations discussed here were made in the last week of May 1953. The general ecological condition of the forest was as follows :—

Ground rocky ; 1,450 ft. above sea-level at Sillari. Soil either black and clayey or red and gravelly, changing from place to place. Deciduous mixed forest with teak and other miscellaneous species, being worked by coppice ; trees 30-40 ft. high. During the end of May practically all trees leafless. Owing to failure of rains during the last 3 years, there was acute drought and the soil was bone dry down to 3-4 ft. below surface. Average rainfall[1] 45 inches per year, most of it being received during June-September. Average temperatures (degrees F.): January—max. 83·6; min. 55·0; May—max. 107·6, min. 82·1; July—max. 87·7, min. 75·2.

The salai tree in question was probably recently dead, within the last 2 or 3 months. The bole and crown were quite dry but the root-stock,



Text-fig. 1. (*Explanation at end*)

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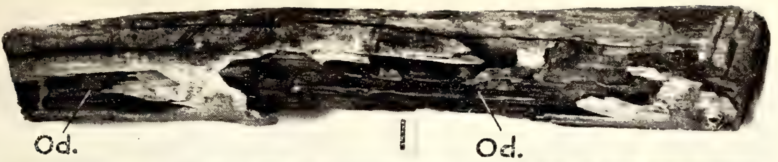
[1] Figures of rainfall and temperature are based on the account of Sagreiya (1936.)



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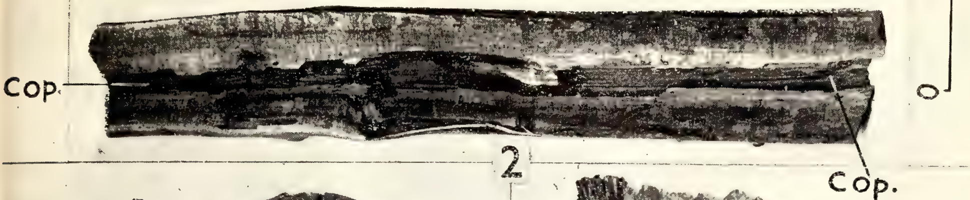

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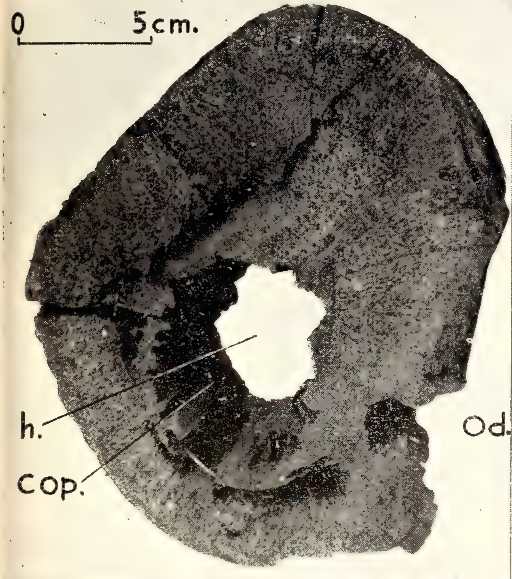

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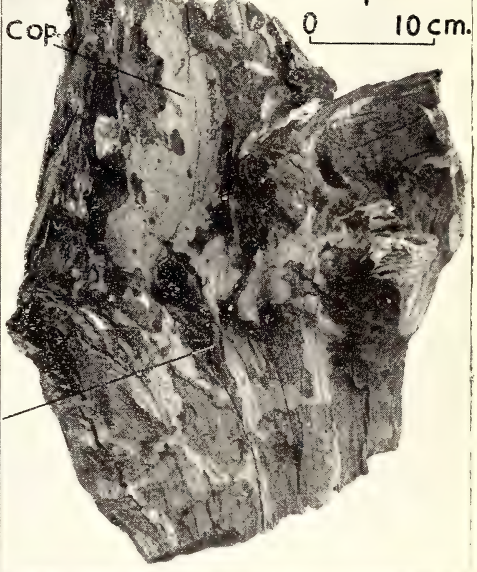

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Lettering Cop., damage by *Coptotermes heimi* (Wasmann) ; *h.*, hole in core of trunk representing the portion eaten by *Coptotermes heimi* (Wasm.). The portion eaten away is converted into a spongy, woody mass whose removal on splitting leaves this cavity ; *Od.*, damage by *Odontotermes redemanni* (Wasmann).

Photographs of the lower portions of the trunk and of the root-stock of a recently-dead, standing tree of salai, *Boswellia serrata* Roxb., showing damage by two species of termites, viz., *Coptotermes heimi* (Wasmann) (family Rhinotermitidae, subfamily Coptotermitinae) and *Odontotermes redemanni* (Wasmann) (family Termitidae, subfamily Macrotermitinae) collected by M. L. Roonwal in last week of May 1953 in Sillari Forest Range, Nagpur-Wardha Forest Division, Madhya Pradesh

Fig. 1. Outer view of part of trunk, to show the portions eaten up by *Odontotermes redemanni*. This species does not attack the core.

Fig. 2. Inner view of same piece as in Fig. 1, longitudinally split in half to show the core eaten up by *Coptotermes heimi*. This species is confined to the core of the trunk and the surface of the root-stock (*cf.* Text-fig.).

Fig. 3. Oblique view of a transverse section of the trunk of the same tree, to show the core entirely eaten hollow by *Coptotermes heimi*. A spongy mass, moulded by the termite out of the eaten up wood, fills this cavity ; it has been removed in the photograph to emphasize the cavity.

Fig. 4. Part of the upper portion of the root-stock of the same tree to show the portions damaged by *Coptotermes heimi* (pale patches, *Cod.*) and by *Odontotermes redemanni* (dark patches, *Od.*).

at least to 4 ft. below the ground surface, was moist and sappy. The following are some other particulars about the tree (also see text-fig. 1) :—

Height of bole (B-G) ...	31 ft.
Height of crown (B-D) ...	8 ft.
Girth at base (G) ...	2 ft.
Girth at breast height (4½ ft. from ground) ...	1 ft. 5 in.

The tree was heavily attacked by the two species of termites mentioned above, but the portions of the tree attacked were sharply separated as described below. The termites collected have been deposited in the Forest Research Institute, Dehra Dun. The termites are characterised as follows :—

Odontotermes redemanni (Wasmann)—This is the commonest termite in the area. It usually builds earthen mounds. It also eats up half-rotten logs and other pieces of wood lying on the ground and the bark on the surface of the sapwood on living and dead standing trees, the termite galleries going high up. Its presence in such cases is characterised by the formation of flat mud-plaster galleries which have the same colour as the ground soil of the area concerned. The termite soldiers and workers swarm beneath these mud galleries, eating up the surface of the wood and filling the eaten portions with earth. In extreme cases a considerable portion of the tree or log is thus hollowed out and filled with earth.

In the salai tree in question, the damage to the bark and the surface of sapwood was typical of this species of termite. The earthen galleries went right up to the top of the crown, 39 ft. up (pl. 1, figs. 1,3,4 ; and text-fig. 1, *Od.*) and on the root-stock at least to 4 feet below the ground (pl. 1, fig. 4, and text-fig. 1, *Od.*) The damage, however, did not go more than one-half inch deep from the surface both in the roots and in the trunk. Soldiers constituted about 2·2 per cent of the soldier-worker population.

Coptotermes heimi (Wasmann)—This is a dry-wood species. The soldiers have a yellow head with a pair of dark-coloured, sabre-shaped mandibles. When the soldier is disturbed the mandibles are opened out and kept in that position for a considerable period of time (2 to 3 minutes). They also secrete, from the fontanelle aperture at the front margin of the head, a drop of milky-white fluid which, on contact with air, sets into a gummy mass within a minute or so. The proportion of soldiers to workers is evidently much higher than in *Odontotermes*, and this feature was noticed throughout the length of the gallery. The soldiers constitute about 33 per cent of the soldier-worker population, as against 2·2 per cent in *Odontotermes redemanni.*

The damage by this species was confined to the 'heartwood' or core of the tree and extended upward to 11 ft. of the bole from the base and downward to about 4 feet of the root-stock. A cylindrical core, of diameter varying from about 2 to 3 inches, was completely eaten away in the salai bole up to 11 ft., leaving a crenulated inner surface (pl. 1, figs. 1-3, and text-fig. 1, *Cop.*). Inside this were formed whitish, spongy masses of a hard, woody substance, evidently composed of wood eaten, digested and excreted by the termite ; these masses were sometimes formed around a thin, pencil-like core of hard, uneaten wood, and were attached to it. The spongy masses were dirty white on the surface, with numerous circular greenish dots all over; when broken, the inside of these masses was seen to be dark-brown.

On the root-stock (pl. 1, fig. 4, and text-fig. 1, *Cop.*) the damage was characterised by shallow, whitish galleries, about 1-2 inches wide, going down irregularly and spreading to the smaller roots and even to the neighbouring ground. The greyish-white colour of the galleries, marked with darker dots at once distinguishes, the galleries of *Coptotermes* from those of *Odontotermes*. The damage to the root-stock differed from that to the bole in two respects, thus: (i) The spongy masses were less numerous on the root-stock than on the bole. (ii) The damage was confined to the surface and not to the core of the root-stock.

II. CONCLUSIONS

It will thus be seen that while the two species of termites inhabited the same tree and ate its wood, one of them, namely *Odontotermes redemanni* (Wasmann), confined its galleries and damage to the surface area, and the other, namely *Coptotermes heimi* (Wasmann), to the core. As far as one can judge by the distribution of the galleries and the damage to the wood, the two species would appear to lead a completely separate existence and thus they provide us with a good example of inter-specific and inter-generic adjustment. In the same, more or less homogeneous habitat, viz., the dry-wood bole, the two species confined themselves to entirely separate and sharply defined niches. Colonies of both species were rich in numbers and were obviously flourishing.

III. SUMMARY

1. An example of ecological adjustment between two species of termites, viz., *Coptotermes heimi* (Wasmann) and *Odontotermes redemanni* (Wasmann), in a recently-dead tree of salai, *Boswellia serrata* Roxb. (family Burseraceae), is described. The example was noted in the forest near Sillari (altitude 1450 ft. above sea-level) about 41 miles NE. of Nagpur in Madhya Pradesh.

2. *Odontotermes redemanni* fed on the surface of sapwood, not going deeper than about one-half inch from the surface both on the bole and the root-stock. On the other hand, *Coptotermes heimi* was confined to the core of the bole, which it completely hollowed out and filled with a hard, spongy, whitish excretory material.

3. The proportion of soldiers in the worker-soldier population was about 2·2 per cent in *Odontotermes redemanni* and about 33 per cent in *Coptotermes heimi*.

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EXPLANATION OF TEXT-FIGURE

Text-fig. 1. Diagrammatic view of a recently-dead, standing tree of salai *Boswellia serrata* Roxb., in the Sillari forest (East Pench Forest Range, Nagpur-Wardha Forest Division, Madhya Pradesh), showing attack by two species of termites, *viz.*, *Coptotermes heimi* (Wasmann) (in the core of the bole) and *Odontotermes redemanni* (Wasmann) (on the bark and surface of sapwood, as indicated by thick, wavy line in text-figure). Last week May, 1953. (*a*) Entire tree in longitudinal section (*b*) Transverse section of the bole at level C.

A, level up to which the *Coptotermes heimi* galleries extend in the bole (11 ft. from ground); *B*, top end of bole; *C*, top of crown; *Cop.*, *Coptotermes* galleries; *G*, ground level; *Od.*, *Odontotermes* galleries; *R*, lowest level to which the *Coptotermes heimi* galleries extend down the root-stock.

NOTES ON LAND LEECHES

BY

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In his 'Notes and Queries on Land Leeches' last December Mr. Smythies raises some interesting questions and gives us the benefit of some very useful observations (Smythies 1953). Although I am not the best person to discuss leeches, I have recently been carrying out some tests of a 'new dope' to which he refers and I have been giving some thought to the very problems which he poses.

Species and Distribution

Leeches are not popular, even among zoologists, and their students are sparse. Workers in India, Pakistan, Burma and Ceylon are fortunate to have available that magnificent work 'The Fauna of British India' in which a volume of Hirudinea by Harding and Moore was published in 1927. It is still available, price 25 shillings, and in spite of its content of technical matter contains much that is readable. Professor J. Percy Moore, who deals with the bloodsucking leeches, was and is a world authority on the subject, although he is now living in retirement in the United States of America. For workers in Malaya and Borneo, two further papers by Professor Moore appeared in the *Bulletin of the Raffles Museum, Singapore* (Moore 1935 and 1938). A general review of the subfamily Haemadipsinae in French by Blanchard was published in 1917 in the *Bulletin de la Société de Pathologie Exotique* (Blanchard 1917).

Land Leeches comprise the subfamily Haemadipsinae of the family Hirudidae (or Gnathobdellidae of some authors) and are confined to Southern and Eastern Asia and to Australasia. Two aberrant species, one from South America and the other from Europe, are also ascribed to the sub-family, but there is no evidence that they are of the land-leech habit. All the species from the Indian region belong to the single genus *Haemadipsa.*

The following species have been described from the Indo-Malaysian Region (excluding Philippines):—

Haemadipsa zeylanica Moquin-Tandon, with very many colour forms widespread over Ceylon, India, Pakistan, Malaya and Borneo.

H. montana Moore, from the mountains of India, Pakistan, and Burma.

H. sylvestris Blanchard, a lowland form from Burma, Malaya, Borneo, Java, and Sumatra.

H. ornata Moore, a mountain species from Assam, said to have a 'stinging' bite.

H. picta Moore, the corresponding mountain species from Malaya and Borneo, also with a stinging bite.

? *H. dussumieri* Blanchard, described from a specimen doubtfully from Southern India.

Tritetrabdella scandens Moore, from Malaya (Penang).
Phytobdella catenifera Moore, from Malaya.

Other related species are known from the Philippines etc.

I cannot claim much ability in identifying these leeches, but the following key (modified after Moore) may be of assistance. I should explain that a leech contains 34 segments (somites) each of which is divided externally into a number of rings (annuli). The number of annuli to the somite can be detected by counting the number between successive pores.

KEY TO LAND LEECHES

1	Middle somites with 5 annuli each ...	*Haemadipsa* 3
—	Middle somites with more or less ...	2
2	Middle somites with 4 annuli ...	*Tritetrabdella*
—	Middle somites with 6 annuli ...	*Phytobdella*
3	Eyes 3 and 4 on adjacent annuli (prehensile papilla well developed) ...	*H. zeylanica*
—	The annuli bearing eyes 3 and 4 separated by a complete or partial annulus ...	4
4	Posterior sucker with a well developed prehensile papilla. Furrow pits poorly developed. Mountains of Indian region ...	*H. montana*
—	Prehensile papilla but little developed. Furrow pits on somites VIII and XI distinct ...	5
5	Sucker rays usually less than 79, colour dull brown with black stripes ...	*H. sylvestris*
—	Sucker rays usually 80 or more, colours bright red and yellow ...	6
6	Sucker rays more than 86. Mountains of Assam	*H. ornata*
—	Sucker rays less than 89. Mountains of Malaya and Borneo ...	*H. picta*

FOOD AND LENGTH OF LIFE

Land leeches certainly do suck blood; Mr. Smythies raises the question as to whether they must have blood to live, or whether they can exist on other substances, such as humus. He points out that leeches seem to be present in such large numbers that it is difficult to believe that they can all obtain a blood meal. The same question has been intriguing me a good deal.

I incline to the belief that they feed only on blood, although I agree that more evidence is needed. I have tried keeping *Haemadipsa zeylanica* in a glass jar containing earth and leaf-litter, covered with cloth to prevent their escape. One group of such leeches, partly engorged when put in, and thereafter deliberately starved, lived for five months, and died off when the jar became dried up during my temporary absence. During these five months the leeches were active whenever the jar was examined but became very thin, and apparently less numerous (they were difficult to count). The reduction in number could, of course, have been due to cannibalism, a phenomenon which has misled workers with other animals, such as trombiculid mites. I can say only that I saw no sign of it, and I assume that the reduction in numbers was due to the natural death rate under such conditions. The fact that the leeches became very thin argues that they obtained no nutriment from the soil, dead leaves, or the soil fauna (of which a variety of minute arthropods were present). As confirmatory evidence Buffalo Leeches (*Hirudinaria manillensis*) have been kept in clean tap-water unfed for more than five months without their getting even thin.

Such evidence is by no means conclusive, but it argues that land leeches can starve for at least five months. The next question is what chance a leech has of getting a blood meal during that period.

I have a patch of lowland dipterocarp forest under observation for other experiments, where land leeches are numerous. Land leeches are always to be found there and I get the impression that in the wetter parts during suitable weather I meet about one per yard of slow walking. Let us assume (and it is an assumption) that there is a resident population of one leech per square yard of valley bottom. Marking experiments have given a fair idea of the small mammal population of this strip of forest. I estimate that in an area of about 100,000 square yards there is a resident population of at least between forty and fifty rats mostly of the species *Rattus mülleri*, *R. rajah*, and *R. whiteheadi*. The area is also used by pigs, mouse-deer and occasional other ungulates, cats and civets of several species, tree-shrews, and shrews—I am considering only mammals which frequent the ground. Estimating from a map I should say that approximately half the area is suitable for leeches, and that the forty or fifty rats cover this area in their home range.

We have therefore, estimating one leech per square yard of suitable land, a population of 50,000 leeches with 40–50 rats and proportionate numbers of other animals to support them. Allowing one feed per 100 days (3½ months) the leeches could be supported on the rats alone at a rate of ten leech-feeds per rat per day. If we allow that rats form roughly half the ground-dwelling mammal population this rate would be reduced to 5 feeds per rat per day. Is this reasonable ? I would suggest that it is.

These calculations must not be taken too seriously. A lot is guesswork. If anything the leech population has been overestimated, perhaps even wildly overestimated, since the leeches are probably concentrated along tracks, giving a false impression of their abundance, and one's impressions are gained from the worst spots rather than from the average. The mammals on the other hand are probably underestimated. Forty or so is the number of marked rats actually known to be present in the area at any one time; there are probably many more unrecorded. The result, however, of overestimating the leeches and underestimating the mammals is a reasonable figure, so we are safe in saying that leeches *can* get sufficient blood to keep them going.

The next question is whether leeches do feed on such mammals as rats in nature. I should like information on that point. I have found leeches in the nasal cavity of rats, but I have never found a wild rat with a leech attached anywhere else. Leeches detach so readily, however, that many could have detached and gone before the rat-trap was visited. I have tried feeding leeches on rats under laboratory conditions, i.e. in small cages. The leech will attach and engorge readily, but the rats I have tried (*Rattus mülleri*, *R. sabanus* and *R. rajah*) have been too skilful at finding the leeches. All leeches tried have been detected before the feed was completed and most were either bitten to death or eaten. It may well be however, that in the wild the rat does not pay so much attention to leeches. Animals other than rats, such as mouse-deer, pigs and so on, would presumably be much less efficient at finding the leeches on their bodies.

HABITS

The next group of questions may be summarised as 'How do land leeches find their prey'? Stammers (1950) gives a useful summary and an account of experiments in the Cambridge journal *Parasitology*. No clear answer can be given to the question, but they seem to use a variety of senses : sight (they have ten simple eyes), a sense of warmth and air-movement, vibration of the ground, smell, and touch. All these senses are used at times, and it seems likely that all are in fact used in finding their prey.

The most interesting question is that of their dropping out of 'trees' on to their host. My own impression is that, although this undoubtedly occurs, it has been much exaggerated. Most land leeches can and do climb on to herbage and low bushes, the sort of vegetation against which animals brush as they pass. Some of the species, *H. ornata* and *H. picta* for instance, are regarded as 'tree-climbing' species, but I think that the word 'tree' must be interpreted as meaning bushes and saplings some five to ten feet high. I have watched leeches dropping from leaves some three to six feet above the ground, but unfortunately they were always ones I had put there myself. Such leeches, however, alerted by my presence would search in all directions. If there was an object beneath them they would reach downwards and, if unable to reach it, would suddenly become limp, let go their hold, and drop. They could be encouraged to drop by an arm held a foot or two beneath them, but they would also drop, although less readily, at an inanimate object such as a *parang* (bush knife). My impression was that they dropped at sight encouraged by warm air currents. They would also drop, however, when there was nothing beneath but something (myself) in the vicinity. This dropping was clearly for a different reason, it would occur when the leech was searching for me, but had come to the end of available leaves and twigs and was unable to make progress in my direction. It would drop to the ground and immediately make for me again.

REPELLANTS

Most of the standard repellants used against insects and mites seem effective against leeches. Dimethyl Phthalate, Dibutyl Phthalate, Benyl Benzoate, 2-ethylhexanediol (Rutgers 612), and tobacco juice all seem effective repellants until they wash off, but they do wash off, and for application to the skin I can offer no remedy. The 'new dope' referred to by Mr. Smythies as reported in *Nature* (Traub *et al* 1952, also IMR 1954, Audy and Harrison 1954) was not, in fact developed specifically as a leech repellant but as a general purpose repellant for impregnating army uniforms against mosquitoes, lice, bedbugs, fleas, and all the other pests of soldiers. It proves to be very effective against leeches, both land and water leeches, and it remained effective even after a lot of wading through rivers and washing of the clothes. The composition of the particular mixture tested was :—

n-butylacetanilide ...	3 parts
2-butyl-2-ethyl-1·3 propanediol ...	3 parts
benzyl benzoate ...	3 parts
emulsifier (' Tween 80 ') ...	1 part.

This concentrate was emulsified with water in which the garments were soaked at the rate of about two fluid ounces per garment (jacket or pair of trousers).

INSECTICIDES

The insecticides Lindane, Aldrin, and Dieldrin have been tried against leeches. In the concentrations usually used against insects they had no effect whatever. (IMR 1954).

QUESTIONS

This is an attempt to give some answer to a few of the questions raised by Mr. Smythies, but I should not like to give the impression that I think these questions are settled. My own slight acquaintance with the subject serves but to impress me with how little is known about one of the most notorious pests of this part of the world. The questions of which I should like most to know the answer are: ' What are the normal hosts of land leeches ?' ' Are leeches ever found on freshly shot animals, if so how often and how many ?' I would also like to know of any actual estimates of leech populations.

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A SYNOPSIS OF THE SPECIES OF THE GENUS *OZOBRANCHUS* (DE QUATREFAGES 1852) HIRUDINEA—ANNELIDA

BY

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INTRODUCTION

During the course of nearly a century and a half, from its first record in 1791 to the present day, this interesting genus *Ozobranchus* de Quatrefages has been represented by only six species recorded by various authors at different times. This synopsis is mainly intended to help those who are interested in the genus, and who might have occasion to come across it. A list of references of the scanty but complete literature available on the genus up to date is given at the end for the guidance of future workers, and an attempt is also made herein to clarify the systematic position of an ill-defined species, viz., *Ozobranchus papillatus* Kaburaki (1921 *b*), on the basis of certain morphological characters.

Our knowledge of the genus *Ozobranchus* can be traced back to the year 1791, when Archibald Menzies (1791) collected a ' new form of leech ' (as it was called by de Quatrefages 1852) from a turtle in the Pacific Ocean between the tropics, and designated it as *Hirudo branchiata.* Various synonyms have been in use for similar specimens such as *Polydora testudinum* (Oken), *Branchellion pinnatum* (Savigny 1822, Grube) and *Branchiobdella menziesi* (de Blainville, Diesing).

It was Savigny (*loc. cit.*) who recognised for the first time that this belonged to a genus altogether different from *Branchellion*, and in 1852 de Quatrefages suggested the generic name *Ozobranchus* for Menzies's *Hirudo branchiata.* In fact de Quatrefages never saw the specimen, nor did he ever define the genus, but only mentioned that the name *Hirudo branchiata* suggested by Menzies was not quite appropriate and instead, he changed the generic name *Hirudo* to *Ozobranchus* (OξOS = branch) thus implying the branched gills by which the genus is characterised. He called Menzies's specimen *Ozobranchus menziesi.*

Ozobranchus branchiatus (*Hirudo branchiata*) Menzies, as described by Menzies in 1791, was an inch in length and had 7 pairs of gills (branchiae). Menzies's description of this is brief and expressive and is worth quoting.

> ' H. depressa attenuata albida, setis lateralibus ramosis utrinque 7 interaneis fuscis bifidis ferlucentibus.
>
> Habitat, in oceano Pacifico, testudini adhaerens '

Similar specimens were later obtained in 1856 by Mr. Rayner, Surgeon of H.M.S. ' Herald ' from the body of a turtle in Shark's Bay, Australia. These measured only half an inch in length (Baird 1869).

In course of time, the genus *Ozobranchus* de Quatrefages had various synonyms in use. Baird (1869) suggested the generic name *Eubranchella* and described Menzies's specimen as *Eubranchella branchiata* as the only species of the genus available up to 1869. Poirer et de Rochebrune (1884) used the generic name *Lophobdella.* Apathy (1890) collected several hundred specimens of a different species from the body of a single individual of the turtle *Thallasochelys corticata* in the Bay of Naples. His specimens were characterised by the presence of only 5 pairs of branchiae and he suggested the generic name *Pseudobranchellion.* His specimens of *Pseudobranchellion margoi* (Apathy) were included in a new family *Chelyobdellidae* intermediate between the families *Ichthyobdellidae* and *Clepsinidae.*

Leon Vaillant (1890) seems to have adopted the generic name *Ozobranchus* and treated it under the sub-family *Branchellionae* of the family *Ichthyobdellidae.* It was Oka (1895, 1904 & 1910) who studied the detailed anatomy of the species *Ozobranchus branchiatus* Menzies, and classified the genus along with *Pontobdella*, *Ichthyobdella* and *Trachelobdella* as opposed to *Carcinobdella* and *Piscicola.*

Harding (1909 & 1927) described leeches collected from Ceylon by Miss Robertson from the body of the terrapin *Nicoria trijuga.* These were characterised by eleven pairs of gills and biannulate abdominal somites and were designated as *Ozobranchus shipleyi.* Shortly after this Oka (1912) collected yet another species from Wuchung, China, identified as *Ozobranchus jantseanus* but with triannulate abdominal somites. Oka (1912) mentioned only three species of the genus to be existing, viz. *O. margoi*, *O. branchiatus* and *O. jantseanus.*

Kaburaki (1921 *a*) described some leeches from the Indian Museum, which were collected from a tortoise *Kachuga donghoka* in the zoological gardens, Calcutta. These, he found to be resembling *O. jantseanus* of Oka (1912), but later they were considered synonymous with *O. shipleyi* Harding (1927). Along with these Kaburaki (1921 *b*) described a new species of *O. papillatus* collected from the body of *Kachuga tectum* in Narbada River in Nagpur. These are characterised by equal-sized abdominal annuli each with a row of conical papillae. Harding (1927) considered this *O. papillatus* also synonymous with *O. shipleyi* which is open for discussion (*vide infra*).

MacCallum (1918) and Nigrelli (1943) obtained a large number of specimens of *O. branchiatus* Menzies, from the body of *Chelone mydas* and studied the anatomy and bionomics of the species in detail.

Lastly, Sanjeeva Raj (1951) collected a new species of *Ozobranchus polybranchus* from the leg of a tortoise *Pelochelys bibroni* on the bank of the river Kille in Porto Novo, South India, which is diagnosed by twenty pairs of digitiform gills and biannulate abdominal somites.

Family **Ichthyobdellidae**

Genus *OZOBRANCHUS* de Quatrefages 1852

Hirudo ... Menzies 1791 *Trans. Linn. Soc.*, London. I. P. 188, Fig. (3).
Polydora ... Oken
Branchellion ... Savigny 1822 *Syst. des. Annel. 1.c.*, p. 109.
Branchiobdella ... De Blainville 1827 *Syst. des. Annel. 1.c.*, p. 556.
Ozobranchus de Quatrefages 1852. *Ann. Sci. Nat.* (*Zool.*) 3, xviii p. 325.

Eubranchella Baird 1869. *Proc. Zool. Soc.*, London, pp. 311–312.

Pseudobranchellion Apathy 1890. *Orvos-termesz, Ertesito*, pp. 110-113 and pp. 122–127.

Ozabranchus Oka 1895, *Zool, Mag.* Tokyo, VII, No. 75.

Body small, divisible into an anterior narrow part the neck, and a posterior broad abdomen, neck biannulate and abdomen bi-or triannulate, usually unequal sized annuli. Abdomen carries lateral, branched, digitiform gills (branchiae) variable in number from 5 to 21 pairs, posterior sucker is large and powerful. Eyes may or may not be visible in adults. Transverse row of papillae may be present on the abdominal annuii. Ectoparasites on marine as well as fresh water chelonians.

Species 1. *OZOBRANCHUS BRANCHIATUS* (Menzies) 1791

Hirudo branchiata Menzies 1791. *Trans. Linn. Soc.*, London, 1. p. 188.

Polydora testudinum Oken.

Branchellion pinnatum Savigny, Grube, *Syst. des. Annel. 1.c.*, 109.

Ozobranchus menziesi de Quatrefages, 1852. *Ann. Sci. Nat.* (*Zool.*) (3), xviii, p. 325.

Eubranchella branchiata Baird 1869. *Proc. Zool. Soc.*, London, pp. 311–312.

Ozobranchus branchiatus Oka 1895. *Zool. Mag.*, Tokyo, vii, No. 75.

Diagnosis.—Seven pairs of lateral digitiform gills (branchiae) in the anterior half of the abdomen and each gill with 4–5 branches. Neck short and protrusible, not prominent. Eyes may be sunk in below the parenchyma in adults and not visible externally. Mouth terminal, ventrally directed. Anus dorsally placed at the base of the posterior sucker. Male genital opening close in front of the female, on the ventral side of the anterior one-third the length of the body.

Dimensions.—Length 6-25 mm., maximum width of body 3-5 mm., diameter of posterior sucker 2-5 mm., length of a gill 1·5-2 mm., colour usually dirty white.

Hosts and habitat.—Menzies collected it from a turtle in the tropical Pacific. Mr. Rayner collected specimens from a turtle in Shark's Bay, Australia. MacCallum (1918) collected specimens from *Chelone mydas* in Key West, Flanders, and Nigrelli (1943) from the fibroepithelial tumours of *Chelone mydas* caught off the coast of Florida.

Remarks.—It is recorded by Nigrelli (1943) that these leeches are to some extent responsible for the growth of the fibroepithelial tumours of the turtle *Chelone mydas* from which they are collected. The hirudin of these leeches is observed to help the growth of the tumours. From a space of about half a square inch on the tumours, as many as 50 leeches were collected.

Eggs of these leeches are fastened to the skin of the turtle, and a chitinous membrane covers them till they are hatched. Two eyes are visible in the young ones, but in the adults they are shown by MacCallum (1918) to have sunk deep into the parenchyma, and are functionless.

Species 2. *OZOBRANCHUS MARGOI* Apathy 1890

Pseudobranchellion margoi Apathy 1890. *Orvos-termesz Eresito*, pp. 110-113 and pp. 122–127.

Ozobranchus margoi Oka 1912. *Annot. Zool. Jap*, viii, pp. 1–4.

Diagnosis.—By the presence of 5 pairs of lateral digitiform gills (branchiae) in the abdominal region.

Hosts and habitat.—Collected from the body of *Thalassochelys corticata* in the Bay of Naples (Mediterranean).

Remarks.—Apathy (1890) created a new family known as Chelyobdellidae for these leeches and placed it intermediate between the families Ichthyobdelildae and Clepsinidae. Apathy (1902) worked out the histology of the light sensory cells of this species.

Species 3. *OZOBRANCHUS SHIPLEYI* Harding 1909

Ozobranchus shipleyi Harding 1909. *Proc. Cam. Phil. Soc.*, xv, pp. 233–234.

Ozobranchus shipleyi Harding 1927. *Faun. Brit. Ind.* (Hirudinia), p. 37.

Ozobranchus jantseanus Kaburaki 1921 *a.* (Not. Oka) *Rec. Ind. Mus.* 1921, xxii, p. 691.

Diagnosis.—Characterised by the presence of 11 pairs of digitiform branchiae in the abdominal region. Somites of the neck region are biannulate, and the annuli are of equal size. The abdominal somites also are biannulate (Harding 1927) but the anterior annulus is larger and carries a row of multipointed papillae. Branchiae arise from the anterior annulus. Two eyes are visible. Anterior sucker carries the ventrally directed mouth. Anus is dorsal at the junction of abdomen and posterior sucker. Two genital openings close to each other are on the ventral side of the first abdominal somite.

Hosts and Habitat:—Collected for the first time from the terrapin *Nicoria trijuga* in Ceylon by Miss Muriel Robertson. Later Indian specimens were collected from the body of *Kachuga donghoka*, *K. smithi* and *K. intermedia* from Rajmahal, Mahanadi, and Ravi respectively. The inclusion of *O. papillatus* Kaburaki as synonymous with *O. shipleyi* Harding is discussed below.

Species 4. *OZOBRANCHUS JANTSEANUS* Oka 1912

Diagnosis.—Eleven pairs of lateral abdominal gills each with 4 to 7 branches. Abdominal somites are triannulate. Eyes are two in number, and are on the dorsal side at the anterior end. Posterior sucker semicircular and powerful.

The male and female genital openings are situated close to each other on the ventral side of the base of neck.

Dimensions.—Length 9 mm., width 2 mm., diameter of posterior sucker 2 mm.

Hosts and habitat.—Collected by Mr. Usui from a turtle at Wuchung, China.

Remarks.—Kaburaki's specimens of *O. jantseanus* Kaburaki (1921 a) are actually synonymous with *O. shipleyi* Harding, because of the biannulate abdominal somites.

Species 5. *OZOBRANCHUS PAPILLATUS* Kaburaki 1921 b.

Diagnosis.—Eleven pairs of lareral abdominal gills. Biannulate abdominal somites. Annuli are of equal size and a row of single sharp-pointed papillae on each annulus. Eyes not visible.

Dimensions.—Strongly contracted specimens measure 7 mm. in length and 4 mm. across the widest region of the body. Colour plain grey.

Hosts and habitat.—Mr. A. E. D'abreu collected from the body of the tortoise *Kachuga tectum* from Narbada in Nagpur.

Remarks.—Harding (1927) considers *O. papillatus* Kaburaki as synonymous with *O. shipleyi* Harding, but I think the species as designated by Kaburaki (1921 *b*) is mainly based on the absence of any trace of eye-like organs, which is not a sufficiently strong point, and his failure to notice any eyes might be due to the fact that eyes sink into the parenchyma below the skin in the adult, as is shown by MacCallum (1918) in the case of *O. branchiatus* Menzies. Kaburaki obviously has not studied the internal anatomy of the species. Nevertheless the fact that each abdominal somite carries two annuli of equal size and a row of sharp single-pointed papillae on each annulus, seem to be markedly distinct features not observed in *O. shipleyi* Harding with which it is said to be synonymous. On the basis of these rather important characters, I feel that *O. papillatus* Kaburaki can be retained as a distinct species by itself. The size of the annuli and the presence of the papillae and their structure are diagnostic features in the morphology of Ichthyobdellan leeches.

Species 6. *OZOBRANCHUS POLYBRANCHUS* Sanjeeva Raj 1951

Diagnosis.—Characterised by the presence of 20 pairs of lateral, abdominal, digitiform gills. Abdominal somites are biannulate and the anterior annulus broader than the posterior. Two oval eyes at the anterior end on the dorsal side. Mouth in the middle of the anterior sucker which is semicircular and ventrally directed. Anus dorsal at the junction of abdomen and posterior sucker which is circular. Genital openings on the ventral aspect of first abdominal somite. Each gill carries 8 to 24 digitiform processes.

Dimensions.—Length 32 mm. in alcohol. Maximum width of body 5 mm. Posterior sucker (diameter) 5 mm. Length of a gill 1·5-2 mm. Colour dull green on the dorsal side and pale yellow on the ventral side.

Hosts and habitat.—Collected from the leg of the tortoise *Pelochelys bibroni* on the river Kille in Porto Novo, S. India.

Remarks.—Gills were actually 21 on the right side and 20 on the left side. No mutilated gill was seen on the left side.

KEY AND TABLE FOR THE IDENTIFICATION OF SPECIES.

1. 5 pairs of gills (branchiae) ... *margoi*
2. 7 pairs of gills ... *branchiatus*
3. 11 pairs of gills
    - (i) triannulate abdominal somites ... *jantseanus*
    - (ii) biannulate abdominal somites
        - (*a*) unequal-sized annuli, and a row of multi-pointed papillae on anterior annulus alone ... *shipleyi*
        - (*b*) equal-sized annuli, and a row of single-pointed papillae on each annulus ... *papillatus*
4. 20 pairs of gills and biannulate abdominal somites ... *polybranchus*

Species	No. of gills.	Abdominal somites	Papillae	Eyes	Length	Hosts and habitat	Locality
O. margoi ...	5 pairs	not known	not known	present	Not known	*Thalassochelys corticata* (marine)	Bay of Naples
O. branchiatus ...	7 pairs	tri-annulate	absent	present (sunk below in adults)	6-25 mm.	*Chelone mydas* (marine)	Pacific
O. shipleyi ..	11 pairs	bi-annulate	present on only anterior annulus	present	5-25 mm.	*Nicoria trijuga* (marine)	Ceylon
O. jantseanus ...	11 pairs	tri-annulate	absent	present	9 mm.	turtle (brackish water)	Wuchung, China
O. papillatus ...	11 pairs	bi-annulate	present on all annuli	not visible	7 mm. (contracted)	*Kuchuga tectum* (fresh water)	Narbada River, India.
O. polybranchus ...	20 pairs	bi-annulate	absent	present	32 mm.	*Pelochelys bibroni* (brackish water)	Kille River, S. India.

Affinities and evolution.—The resemblances of the genus *Ozobranchus* to the genus *Branchellion* are not only superficial in having the branchiae of similar structure but they are more deep rooted in their nature. It has been shown by de Quatrefages (1852) that the blood vessels of *Branchellion* are closed and have no connection whatsoever with the body cavity, which is branched and which supplies the haemocoelomic-fluid to the gills. A similar condition is observed by Oka (1895 and 1904) in *Ozobranchus branchiatus* Menzies. Hence with regard to this and many other features the genus *Ozobranchus* possesses closer affinities to the genus *Branchellion* than any other Ichthyobdellan. In fact our knowledge of the internal anatomy and embryology of the genus is too incomplete to justify any attempt to explain the evolution within the genus itself. Nevertheless the progressive increase in the number of gills from *O. margoi* to *O. polybranchus* can be looked upon as a transitory basis of evolution till the genus is more thoroughly understood.

Geographic distribution.—The genus *Ozobranchus* has been recorded from the Australian, Palaearctic, Nearctic, and Oriental Regions.

Australian Region.
  O. branchiatus (Menzies). Shark's Bay, Australia.

Palaearctic Region.
  O. margoi (Apathy). Bay of Naples, Mediterranean.
  O. jantseanus (Oka). Wuchung, China.

Nearctic Region.
  O. branchiatus (Menzies). Key West & Florida.

Oriental Region.
  O. shipleyi Harding. Ceylon and India.
  O. papillatus Kaburaki. R. Narbada, N. India.
  O. polybranchus Sanjeeva Raj. R. Kille, S. India.

O. branchiatus (Menzies) has been recorded from both the Australian and American (Nearctic) Regions, but it is abundant in the latter.

Hosts and habitat.—The members of the genus have been recorded always as ectoparasites on marine turtles and fresh water tortoises. There seems to be no specificity of the host within the Chelonians, for, the same species of leech is collected from different species of tortoises. It has been shown by Nigrelli (1943) that they feed on blood of the host, and breed on its body. The eggs are attached to the host and covered over by a chitinous membrane till the young are hatched out. These leeches are extremely contractile in life.

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A NEW SPECIES OF *ARTHRAXON* FROM PURANDHAR (BOMBAY STATE)

BY

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(*With a plate*)

While studying the calcicolous associations of the Bombay State, the authors came across an interesting species of *Arthraxon* growing exclusively on the walls of Purandhar Fort, which is situated at a height of 4,500 ft. above sea-level, 26 miles from Poona (1).

It should be stated at the outset that there are six recorded species of *Arthraxon* to be found in the Bombay State, namely *A. inermis* Hook., *A. serrulātus* Hochst., *A. meeboldii* Stapf, *A. lancifolius* Hochst., *A. quartinianus* Nash., and *A. jubatas* Hack. (2,3). It is interesting to note that all of them are seasonal and flower during the monsoon. All are calcicolous and are found growing luxuriantly on walls (1,2).

The *Arthraxon* species collected by us did not agree with any species hitherto recorded but in its inflorescence appeared to have close affinities with *A. meeboldii* Stapf, which is also an endemic in the Bombay State. By the kind permission of Rev. Fr. H. Santapau, S.J., we examined the collection of *Arthraxon* in the Blatter Herbarium but we could not find any specimen corresponding to ours. Our species is, therefore, being described here as a new species and it is named after the Purandhar Fort on which it was found.

Arthraxon purandharensis Bharucha, spec. nov.

It is distinguished by its large leaves and inflorescence, larger wider long-awned spikelets, spinulous murications of the lower involucral glume with its tip entire, small anthers and the 7-nerved lower glume of the pedicellate spikelet.

Herba annua. *Culmi* 40–60 cm. alti, validi, ramificantes ad nodos, qui sunt pubescentes atque rubrobrunnei. *Foliorum lamina* ovato-lanceolata, setacee acuminata, late amplexicaulis ad basim, usque ad 8 × 2 cm., pilis nitentibus, bulbo infixis pilosa sparse supra, dense infra, ciliata ad margines pilis bulbo infixis, 9-nervia, nervis aliquantum elevatis et prominentibus in pagina inferiore. *Vaginae* longae 2–2.5 cm., 5.5 mm. latae, culmis adpressae, subtiliter sulcatae, pilosae praesertim ad insertionem laminae. *Ligula* scariosa, ad 9 mm. longa.

Racemi terminales paniculati, emergentes ex supremi folii vagina, 4-6-ramificati, 8 cm. longi, spatha 9 × 1·2 cm.; inferiores rachides confluentes; rhacheos nodi tumescentes, dense vestiti pilis longis atque argenteis. *Spiculae sessiles* viridi-luteae, 6–8.5 mm. longae, anguste lineari-lanceolatae, uniflorae, ornatae callo brevi atque barbato. *Gluma inferior* 8 mm. longa, 2 mm. lata, lineari-lanceolata convexa ad tergum, apice integro, coriacea vel chartacea, marginibus incurvis, eminenter carinata

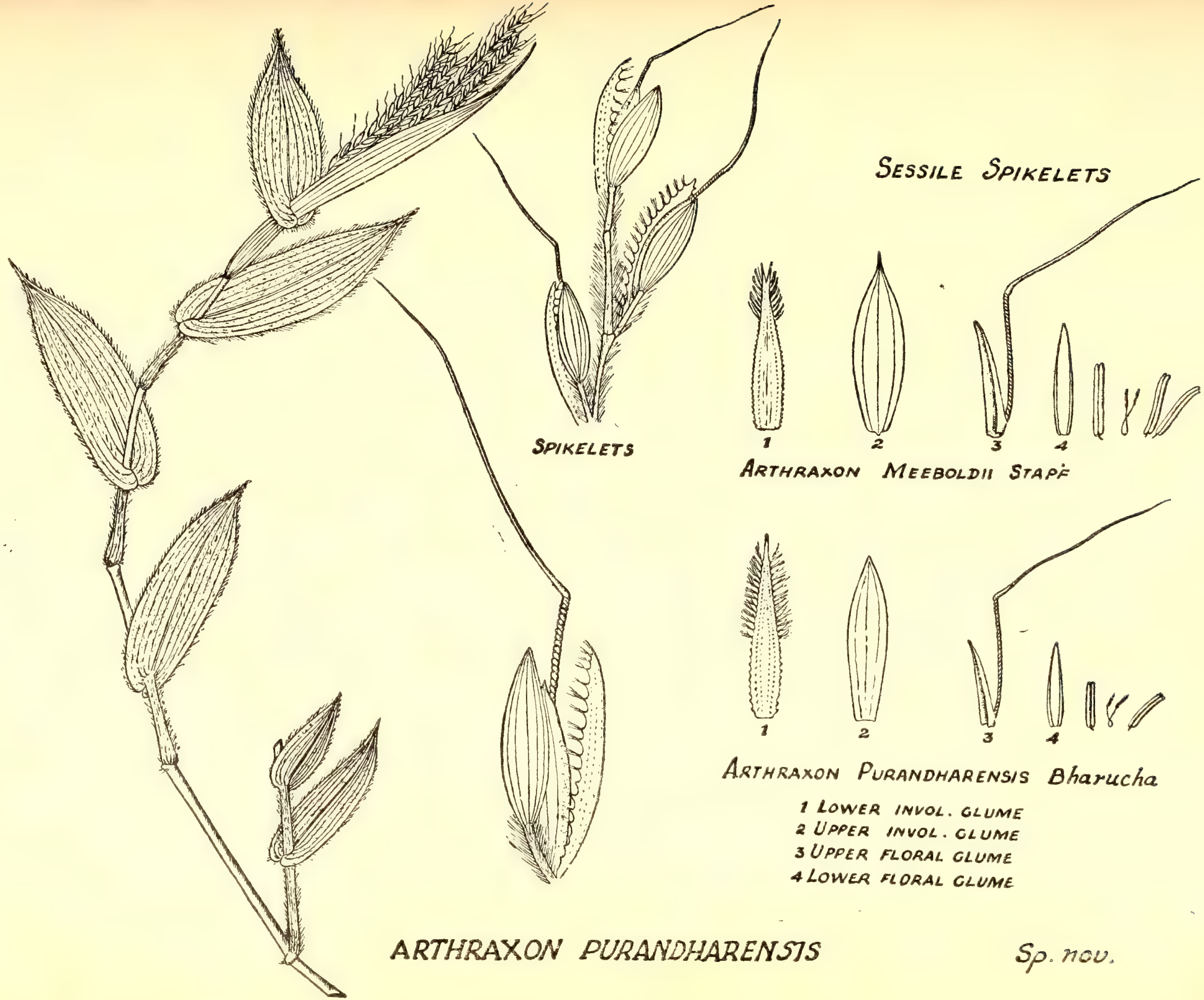
carinis serratim muricatis vel echinulatis ; muricationes augentur magnitudine sursum in gluma ; tuberculorum duplex series adest, quae in superiore parte glumae evadit ciliata pilis tenuibus erectisque ; nonnumquam 4 nervi distincti adesse possunt, qui sunt tenuiter eminentes, nervis exterioribus spinulose muricatis. *Gluma superior* 7 mm. longa, 2.2 mm. lata, oblongo-lanceolata, acuminata, chartacea, 6–nervia marginibus hyalinis. *Gluma inferior floralis* 3·5–4 mm. longa, 0·8 mm. lata, lineari-lanceolata, acuta, marginibus hyalinis, nervis nullis apparentibus, atque vacua. *Gluma floralis superior* 5 mm. longa, 1 mm. lata, lineari-lanceolata, acuta, aristata fere ex basi ; arista dorsalis 21 mm. longa, geniculata atque obtorta supra geniculum, inferiore parte levi atque glabra, superiore vero supra geniculum aspera atque 12 mm. longa ; *Lodiculae* quadratae et hyalinae ; *Stamina* ut plurimum duo, raro tria ; *Antherae* pallide virides, evadentes brunneae, 1.5 mm. longae, breviores quam dimidia pars glumae floralis superioris. *Stigma* bifidum atque plumosum ad apicem.

Spiculae pedicellatae ca. 8.2 mm. longae, pediculis 2.5 mm. longis, dense vestitis pilis longis argenteisque ; spiculae arcte adpressae spiculis sessilibus, ovato-lanceolatae, acutae, chartaceae. *Gluma involucralis inferior* ca. 5·7 mm. longa, 1·4 mm. lata, 7-nervia, glabra vel ciliata, marginibus incurvis, hyalinis, et minutim muricatis. *Gluma involucralis superior* 5·6 mm. longa, 1·1 mm. lata, subtiliter striata, lanceolata atque acuta, hyalina atque 3-nervia, marginibus inflexis. *Glumae florales inferior atque superior* vacuae, chartaceae, 3·4–4 mm. longae, 0·8 mm. latae, ovatae et lanceolatae.

Typus lectus a F. R. Bharucha, in parietibus castri ad Purandhar, mense octobri, 1952, (Bharucha 501) et positus in Herb. Inst. Sci. in Bombay, India.

An annual grass. *Culms* from 40 to 60 cm. high, robust, branching at the nodes which are pubescent and reddish brown. *Leaf-blades* ovate-lanceolate, setaceously acuminate, base broadly amplexicaul, upto 8 cm. long, 2 cm. wide, covered with bulbous-based shiny hairs, sparsely on the upper and densely on the lower surface, ciliate on the margins with bulbous-based hairs, 9-nerved, the nerves being slightly raised below. *Sheaths* long, from 2 to 2·5 cm. long, 5·5 mm. broad, closely attached to the culms, finely grooved, covered with hairs especially at the junction of the lamina. *Ligules* scarious and 9 mm. long.

Inflorescence of paniculate terminal racemes issuing from the topmost leaf-sheath with 4–6 branches, 8 cm. long, sheath about 9 cm. by 1·2 cm. ; the lower rachii are confluent ; joints of the rhachis swollen, densely clothed with long and silvery hairs ; *Sessile spikelets* greenish-yellow, 6 to 8·5 mm. long, narrowly linear-lanceolate, one-flowered, callus short and bearded ; *lower involucral glume* 8 mm. long, 2 mm. wide when flattened, linear-lanceolate, convex at the back, tips entire, coriaceous to chartaceous, margins incurved, keeled prominently, keels serrately muricate, murications increasing along the entire length of the glume, two additional rows of tubercles present which in the upper half of the glume are ciliated with fine erect hairs ; sometimes four distinct nerves may be present which are slightly raised and the outer nerves are spinulously muricate. *Upper involucral glume* 7 mm. long, 2·2 mm. broad when flattened, oblong-lanceolate, acuminate, chartaceous, 6-nerved with hyaline margins ; lower floral glume 3·5 to 4 mm. long, 0·8 mm. broad, linear-lanceolate, acute with hyaline margins, nerveless and empty. *Upper floral glume* 4 mm.


SPIKELETS
SESSILE SPIKELETS
1
2
3
4
ARTHRAXON MEEBOLDII STAPF
1
2
3
4
ARTHRAXON PURANDHARENSIS Bharucha
1 LOWER INVOL. GLUME
2 UPPER INVOL. GLUME
3 UPPER FLORAL GLUME
4 LOWER FLORAL GLUME

ARTHRAXON PURANDHARENSIS Sp. nov.

long, 1 mm. broad, linear-lanceolate, acute, aristate from near the base, the dorsal awn 21 mm. long, bent and twisted above the knee, lower half smooth and glabrous, upper half above the knee rough and 12 mm. long, lodicules quadrate and hyaline, stamens generally two, rarely three, anthers light-green, turning brown later, 1·5 mm. long, less than half the length of the upper floral glume, stigma bifid and plumose at the top.

Pedicellate spikelets about 8·2 mm. long, pedicels 2·5 mm. long, densely clothed with long silvery hairs, closely appressed to the sessile ones, ovate-lanceolate, acute, chartaceous, *lower involucral glume* about 5·7 mm. long, 1·4 mm. broad, 7-nerved, glabrous to ciliate, with hyaline incurved margins, minute murications present along the margins; *lower involucral glume* 5·6 mm. long, 1·1 mm. broad, finely striated, lanceolate and acute, margins inflexed, hyaline and 3-nerved, *upper and lower floral glumes* are empty, chartaceous, 3·4 to 4 mm. long, 0·8 mm. broad, ovate and lanceolate.

Arthraxon purandharensis and *Arthraxon meeboldii* are no doubt closely related but a number of characters both minor and major separate them out at once. The anthers in *A. purandharensis* are much smaller than those of *A. meeboldii* and are generally less than half the length of the upper floral glume. Again, whereas in *A. meeboldii*, the number of stamens is consistently three, in *A. purandharensis*, the number is variable, being generally two and rarely three. Both the species possess the peculiar type of murications in the lower involucral glume, but the murications are spinulous, broader and more pronounced along the entire length of the glume in *A. purandharensis.* This, in addition to the two definite rows of tubercles and the presence of silky hairs over half the length of the glume at once distinguishes it from *A. meeboldii.* Again, the racemes are more in number and much longer in *A. purandharensis* than in the related species. Finally the large leaves with 9 prominent nerves should distinguish it at once from *A. meeboldii.* In addition, *A. purandharensis* occupies a restricted geographical range, being found only in an isolated fort in the Deccan. It is, therefore, considered by the authors to be a new species, warranting a specific rank.

The authors wish to express their thanks to Rev. H. Santapau, S.J., St. Xavier's College, Bombay, for kindly translating into Latin the description of the species, Dr. N. L. Bor, Asst. Director, Royal Botanic Gardens, Kew, Dr. S. K. Mukherjee, Curator, Indian Botanic Gardens, Calcutta, and Shri M. B. Raizada, Indian Forest Research Institute, Dehra Dun, for their help and assistance.

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THE VEGETATION OF PILANI AND ITS NEIGHBOURHOOD

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(*With a map*)

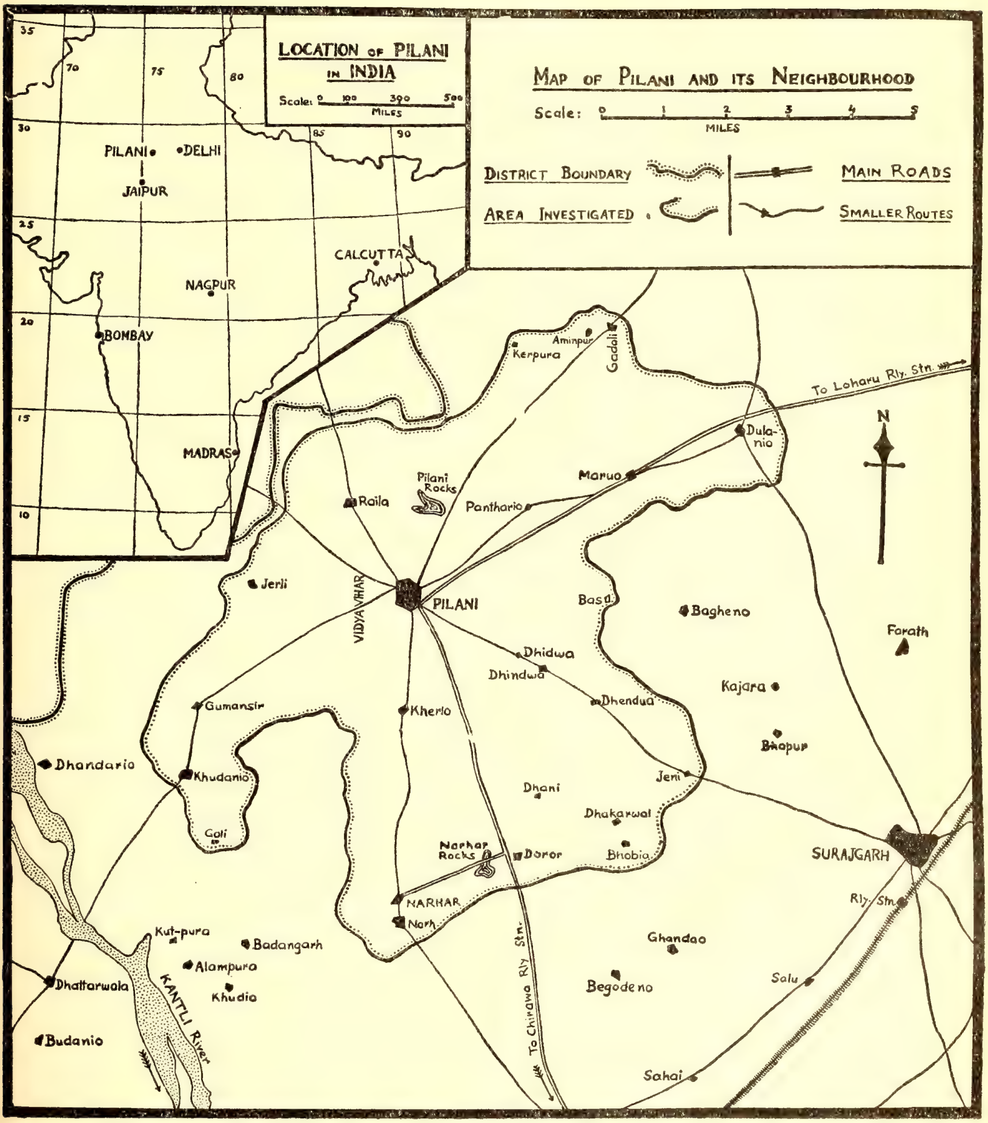
INTRODUCTION

As early as 1879, King made an attempt to study the flora of Rajputana and published a short 'sketch' of the same. This was followed over a quarter of a century later by the much more comprehensive work of Blatter and Hallberg (1918–21). Since then the study of the Rajputana desert vegetation received scant attention of taxonomists almost till 1950, when a few authors including Mulay and Ratnam (1950), Ramachandran (1950), Das and Sarup (1951), Ratnam (1951), Sankhala (1951), and Sarup (1951) tried to revive interest in the subject by preparing lists of plants occurring in their neighbourhood. Simultaneously, a few more devoted themselves to the ecological and morphological aspects of the vegetation (Biswas and Rao, 1952; Ratnam and Joshi, 1952; Sarup 1952; Bakshi and Kapil, 1953, 1954; Bakshi and Chhajlani, 1953, 1954; etc.). If this enthusiasm is continued through the efforts of individual botanists as well as organizations, it may not be too much to expect in the near future a revision of the pioneer work of Blatter and Hallberg (1918–21). This in its turn would help immensely in the re-writing of a new Flora of India (see Santapau, 1952).

It is interesting to note that, whereas western and north-western Rajputana has been studied to a certain extent, the remaining part of this vast arid region has received little attention. Whatever earlier records we have of the floristic studies of eastern Rajputana, appear to be included in 'The Flora of the Indian Desert' (Blatter and Hallberg, 1918–21). Of the more recent ones, Ratnam's 'The Vegetation of Lohargal' (1951) appears to be the only comprehensive account; the other two (Mulay and Ratnam, 1950; Ramachandran, 1950) are published in a summary form in the *Proceedings of the Indian Science Congress*, and as such are of little help in determining the detailed vegetation of the area studied. Incidentally these latter two deal with the vegetation found in and around Pilani. Needless therefore to say that the present paper is the first detailed account of the plants of Pilani and its adjacent areas. However, for purely ecological studies reference may be made to the works of Sarup (1952), Ratnam and Joshi (1952), and Bakshi and Kapil (1953 and 1954).

Pilani, situated a little over 100 miles to the west of Delhi (*vide* map), was originally a small village in the Jaipur State. Now, however, it has sprung up into one of the important educational centres of India due primarily to the efforts of the Birla Education Trust through more than half a century. Recently, with the foundation of the Central Electronics Engineering Research Institute, it is expected to attract

THE VEGETATION OF PILANI


LOCATION OF PILANI IN INDIA
Scale: 0 100 300 500
MILES
35
30
25
20
15
10
70
75
80
85
90
PILANI
DELHI
JAIPUR
CALCUTTA
NAGPUR
BOMBAY
MADRAS
MAP OF PILANI AND ITS NEIGHBOURHOOD
Scale: 0 1 2 3 4 5
MILES
DISTRICT BOUNDARY
AREA INVESTIGATED
MAIN ROADS
SMALLER ROUTES
N
To Loharu Rly. Stn.
Aminpur
Kerpura
Gadoli
Dula-nio
Maruo
Pilani Rocks
Raila
Panthario
Jerli
VIDYA VIHAR
PILANI
Basa
Bagheno
Forath
Dhidwa
Dhindwa
Dhendua
Kajara
Bhopur
Gumansir
Kherlo
Dhandario
Khudanio
Goti
Jeni
Dhani
Dhakarwal
Narhar Rocks
Doror
Bhobia
SURAJGARH
Rly. Stn.
NARHAR
Narh
Ghandao
Begodeno
Salu
Sahai
Kut-pura
Badangarh
Alampura
Khudio
Dhattarwala
Budanio
KANTLI River
To Chirawa Rly. Stn.

much wider attention. The region was barren and desolate till as late as 1946. Ever since, thanks to the digging of a number of tube wells and the growing concern of the local authorities, Pilani is becoming greener every year.

ENVIRONMENTAL FACTORS INFLUENCING THE VEGETATION

Little is known about the meteorology of deserts; I, therefore, tried to collect as much data as was possible. The climate of Pilani is typical of the arid regions of Rajputana. According to the records in the local Agriculture Farm, Pilani receives an average annual rainfall of about 14 inches. During 1950–51 it was 13·25 inches (Ratnam and Joshi, 1952). 1951 was a little drier with only 11·47 inches of rain of which 7·84 inches was received in August, about an inch each in June and October, and less than an inch each in May, July and September (Bakshi and Kapil, 1954). The remaining months are almost dry. It appears the low rainfall is due to the fact that the area is inaccessible to the south-west monsoons rising from the Arabian Sea. The clouds float very high above the vast arid barren region and are usually carried away from the tract. The percentage of humidity varies considerably. It may be 31, or even lower on some particularly hot days during the April–June period, or it may rise up to nearly 70 in August, the month receiving the maximum of rainfall. August is also particularly conspicuous in showing some characteristic features. The clouds roll up on most of the days but rain of some consequence is released on just two or three occasions in the month, the remaining period experiencing a few light showers only. Rainwater is either quickly drained off due to the typical topography, or is immediately absorbed by the sandy soil, so that after rain the soil surface is just wet and not muddy.

As in Jodhpur (Sarup, 1952) there is a constant breeze in Pilani from the south-west to the north-east from about February to October with a velocity of nearly 8–10 miles per hour. The velocity increases during May to 20 and the direction changes to west-east. Storms of higher velocity are also not infrequent.

May and June are the hottest months with the average maximum temperature of about 108° F. It diminishes to about 80°F in the winter months, especially January. The minimum temperature in June is on an average 85°F and in January about 45–50°F. On some particularly cold nights there is a crust of ice formed on the surface of drain-water; the mercury obviously touches the freezing point. Figures for the respective temperatures of the soil are not available but it was observed that in summer the soil is much hotter than the atmosphere and in winter much cooler. A detailed study of the effect of these soil temperatures on the plants growing thereon can yield fascinating results.

The physical nature of the soil varies from locality to locality. For example, in the Agriculture Farm it is almost black and is composed of humus and a little clay, and the soil is spongy. Humus is absent in other regions where the soil shows varying proportions of silt, clay and sand. The so-called fields surrounding the Vidyavihar (Educational Colony) are nothing but vast stretches of sand. Sand dunes, mostly of the *Barchan* type (see Bagnold, 1939) and of various sizes and heights, add considerably to the characteristic topography of Pilani. To the south of Vidyavihar, there are also present a few sand hills. A little to the north of Pilani, there is a small hillock of loose gravel (see 'Pilani Rocks' in map). An almost similar hillock is present near Narh along the Pilani-Chirawa road.

Water content of the soil varies considerably not only in different localities but also in the same locality at different spots. According to Bakshi and Kapil (1953, 1954) who have recorded it for different depths, the percentage of the water content ranges from 1·2 (at a depth of 3 cm.) to 6·8 (at a depth of 10 cm.) in August—the wettest month. Ratnam and Joshi (1952) have found the percentage in one locality to be as low as 0·87. The depth at which the soil sample was collected is not given. The central area of the temporary pond studied by them shows as high a percentage as 15·75. The difference in all these figures may be accounted for by one or more of the following reasons :

1. Difference in water retaining capacity of various soils.
2. Periodic watering of fields.
3. Artificial storage of water, as near the brick-kiln.
4. Collection of drainage water.
5. Varying topography of the land.

The chemical nature of the soil is characteristic. The carbonate content is very low, nitrates are in plenty, and the reductivity usually 1. The pH value ranges from 7 to 8·5 (Bakshi and Kapil, 1953, 1954). Ratnam and Joshi (1952) record the pH as varying from 4 to 8·5. The lowest figure is predominant on the south-east of the pond included in their study. To me the figure, however, appears to be too low for the region.

The vegetation of Pilani—in fact the vegetation in most of the arid Rajasthan—is subjected to two very destructive biotic factors : man and grazing cattle, especially goats and sheep. Cutting the tops of trees for foliage to be used as fodder in the off-season, felling trees for fuel, and collecting herbs of the rainy season for cattle are some of the most destructive methods which affect the plants so adversely that they are in constant danger of vanishing should these agencies continue with a little greater 'zeal'. All these practices lay bare the sandy soil to the nearly constant breeze for rapid erosion. In Jodhpur (Sarup, 1952) an attempt has been made to introduce *Prosopis juliflora* DC., an Australian plant, which is more leafy, less woody and grows more rapidly than the native species. It coppices well and the trees come up self-sown. If large-scale planting of the species is encouraged in a wider area, the arid regions can be profitably improved.

General Aspects of the Vegetation

From the foregoing details it is seen that the rainfall in Pilani is scanty, the percentage of relative humidity low, the hot or cold winds almost constant, and the temperatures extreme. Added to these is the almost dry sandy soil. These factors are hardly favourable for a luxuriant growth of plants. The chief features of the existing vegetation are discontinuous patches of plant associations. The species comprising these plant communities vary from patch to patch and give the region the appearance of a typical scrub jungle. As Elston (1953) has suggested, vegetation if it is to survive must establish an equilibrium with the environment in which it develops. Since the availability of water is the most important limiting factor of arid environments, most of the plants in Pilani, like all other desert plants, exhibit characteristic features of xerophytes. The leaves are either almost completely absent, as in *Capparis aphylla* Roth., *Leptadenia spartium* Wight or *Ephedra foliata* Boiss. var. *ciliata* (C.A. Mey) Stapf., or if present are very small with their transpiring surface reduced to the minimum as in *Farsetia jacquemontii* Hook. f. & T. and *Crotalaria burhia* Buch. The epidermal outgrowths and coverings are very common on all the exposed parts of plants. Presence of thorns, spines, prickles, development of phylloclades, reduction of the exposed surface in proportion to the one underground, formation of long roots, and perennation by underground organs are features most commonly met with in the region.

On the basis of the source of water supply, the entire vegetation can be divided into two groups. To one belong the herbaceous annuals like *Mollugo cerviana* Ser., *Cleome viscosa* Linn. and *Digera arvensis* Forsk. which derive their water supply directly from the rains. These appear with the first showers, flower within a few days, and disperse the seeds shortly afterwards. The life span of such plants is about 1-3 months. The second group comprises plants which draw water from the deeper layers of the soil. To this category belong the perennials like *Capparis aphylla* Roth., *Celastrus senegalensis* Lamk., *Prosopis spicigera* Linn., *Calatropis procera* R. Br., and others. Besides these there is, however, a third group of plants which are annuals to all appearances but which perennate by some underground parts and sprout into new plants in the succeeding favourable season. This important category includes species like *Tribulus terrestris* Linn., *Trianthema monogyna* Linn., *T. crystallina* Vahl., *Gisekia pharnaceoides* Linn., *Tridax procumbens* Linn., *Boerhaavia diffusa* Linn., *Polygonum plebejum* R. Br. *Pupalia lappacea* Juss., etc. Some of these continue to produce shoots and flowers in suitable spots till late in the season. There are others which grow here with the same vigour as they do in the Upper Gangetic Plain. Species of *Tephrosia* and *Ocimum* are conspicuous in this respect. The commonest and the most successful annuals belong to the Capparidaceae, Zygophyllaceae, Leguminosae, Cucurbitaceae, Ficoideae, Compositae, Convolvulaceae, Nyctaginaceae, Amarantaceae, Chenopodiaceae, Euphorbiaceae, Commelinaceae and Gramineae. Mukherjee (1953) has recorded for the Delhi 'Ridge' the same families with the exception of Zygophyllaceae, Ficoideae, Nyctaginaceae and Euphorbiaceae. It is important to note that the Ficoideae, the species of which are probably the most frequent in Pilani, is not even one of the predominant families in Delhi (Mukherjee, 1953).

VEGETATIONAL COMPLEX AND PLANT COMMUNITIES

Hooker (1904), Hooker and Thomson (1855) and Calder (1938) have given a very useful outline of the vegetation of India. They have pointed out that, of the various types of vegetation found in India, the dry forests occur in Rajputana and the Punjab. Dudgeon (1920) has recorded the same for the Upper Gangetic Plain, especially Agra. The dominant families are Capparidaceae, Leguminosae, Salvadoraceae, Tamaricaceae and Rhamnaceae. The important trees include species of *Prosopis*, *Tamarix*, *Salvadora*, *Acacia*, *Zizyphus* and *Capparis*. The vegetation of the Agra plains, is therefore, continuous with the dry forests of Rajputana 'characterised by *Anogeissus pendula* Edgw., *Acacia senegal* Willd., *Prosopis spicigera* Linn. and species ot *Boswellia*, *Balsamodendron*, *Moringa* and *Rhus*'. Pilani with its dominant plants like *Capparis aphylla* Roth., *Prosopis spicigera* Linn., *Anogeissus pendula* Edgw., *Salvadora persica* Linn. and species of *Zizyphus* further confirms such an assumption.

The vegetation of Pilani is so discontinuously distributed into patches that it is difficult to form any definite idea of the prevailing plant communities. Ratnam and Joshi (1952) have recorded no fewer than nine such associations in a small area of about 1½ square miles. Some of these like the *CAPPARIS-ZIZYPHUS* ASSOCIATION (with species of *Capparis*, *Zizyphus Coccinia*, *Achyranthes*, *Commelina*, *Cenchrus*, *Tephrosia*, *Spermacoce*, *Polygala*, *Abutilon*, *Justicia* and *Corohorus*), *GYMNOSPORIA-EPHEDRA* ASSOCIATION (comprising species of *Gymnosporia*, *Ephedra*, *Tephrosia*, *Polygala*, *Spermacoce*, *Cenchrus*, *Eragrostis*, *Mollugo*, *Setaria*, *Corchorus*, *Euphorbia*, *Digera*. *Coccinia* and *Trianthema*), *TEPHROSIA-MOLLUGO* ASSOCIATION (including species of *Tephrosia*, *Mollugo*, *Spermacoci*, *Euphorbia Cenchrus*, *Polygala*, and *Gisekia*), and *ARGEMONE-MOLLUGO* ASSOCIATION (with species of *Argemone*, *Mollugo*, *Polygonum* and *Calotropis*) are fairly constant in Pilani and its adjacent localities, but it is rather difficult to mark out others in a wider area.

LIST OF SPECIES

During 1950-52 as many as 312 (including 41 cultivated) species belonging to 70 families were collected from Pilani and its neighbourhood, an area of approximately 40 square miles (*vide* map). A list of these is given below. Attempt has not been made to give any detailed description of plants or else it would have resulted in a 'Flora Pilaniensis'. Moreover, the details of these plants can always be had rather easily in the other available floras. In most cases the habit of the plant and the colour of the flower follow the name of the species. Occasionally, however, the limit has not been adhered to especially when observations different from the earlier records were made. 'Vern' stands for vernacular names commonly employed in the region investigated.

The list is not claimed to be an exhaustive one. The difficulty of communications along the unbroken expanses of undulating, sunbaked and windswept sand dunes, the overwhelming light and temperature, and the scarcity of water are factors anything but encouraging for undertaking long journeys into the interior of the desert. This undoubtedly speaks for the investigated area being restricted along either the main roads or the smaller routes. Much work, both in the fields of taxonomy and ecology, remains to be done, and it is to this aspect that the attention of the botanists permanently stationed at Pilani is hereby drawn. Of the more important areas to be studied the exploration of the region through which the river Kantli flows (see map) can prove to be fascinatingly fruitful.

According to the number of species in a family, the following families have been found to be predominant: Leguminoseae (39), Gramineae (25), Compositae (19) Amarantaceae (15), Convolvulaceae

(12), Solanaceae (11), Euphorbiaceae (10), Cucurbitaceae (9), Cruciferae (9) and Ficoideae (8). Sabnis (1929) has given the dominant families for the deserts of Sind and Rajputana and the Indus Delta. For the Rajputana desert he includes Gramineae, Leguminosae, Compositae, Cyperaceae, Convolvulaceae, Amarantaceae, Boraginaceae, Cucurbitaceae, Euphorbiaceae, Acanthaceae and Malvaceae. It is seen, therefore, that the families Cyperaceae, Boraginaceae, Acanthaceae and Malvaceae are rather poorly represented in Pilani and its neighbourhood in comparison with the rest of the Rajputana desert.

RANUNCULACEAE

1. **Ranunculus muricatus** Linn. (Syn. *R. cabulicus* Boiss.)

Commonly cultivated in gardens.

2. **Delphinium ajacis**

The common Larkspur with blue flowers. A garden plant.

ANONACEAE

3. **Anona squamosa** Linn. (Vern. *Sitaphal*)

A small tree or shrub, nearly evergreen. Cultivated. Fruit ripens in July-Sept.

4. **Polyalthia longifolia** Benth. & Hook. f. (Vern. *Ashok*)

A handsome evergreen tree. Planted in avenues.

MENISPERMACEAE

5. **Tinospora cordifolia** Miers.

A glabrous climbing succulent shrub flowering in the hot and rainy seasons. Root and stem antidote to snake-bite.

PAPAVERACEAE

6. **Papaver rhoeas** Linn. (Vern. *Lalpost*)

An ornamental plant.

7. **Argemone mexicana** Linn. (Vern. *Satyanashi*)

A common weed of low-lying lands. Fl. cold season.

8. **Fumaria parviflora** Lamk. (Vern. *Pitpapra*)

A diffuse much-branched herb. Fl. Jan.–March. Common in fields.

CRUCIFERAE

9. **Farsetia jacquemontii** Hook. f. & T.

A herb with minute leaves and erect, spreading and green stems. Flowers white. Shows monstrosities with the production of several buds in one axil. The resulting branches remain attached to each other along their entire length.

10. **Senebiera pinnatifida** DC.

A prostrate hispid annual weed of cultivated fields. Fl. cold season. Frequent.

11. **Capsella bursa-pastoris** Medik.

A common weed of cultivation during the cold season.

12. **Lepidium sativum** Linn.

A cold weather garden plant.

The cultivated plants of the family include: 13. *Brassica oleracea* Linn., 14. *B. napus* Linn. (Syn. *Sinapis dichotoma* Roxb.) 15. *B. campestris* Linn. var. *rapa* (Linn.) Hart. (Vern. *Sarsu*). 16. *B. cernua* (Thunb.) Forbes & Hans. 17. *Raphanus sativus* Linn. (Vern. *Mur*).

CAPPARIDACEAE

18. **Cleome viscosa** Linn. (Vern. *Jangliarhar*)

An erect glandular, pubescent annual with yellow flowers. Fl. rainy season. Frequent.

19. **Gynandropsis pentaphylla** DC. (Syn. *G. gynandra* Merrill)

Dominant herb of waste lands. Fl. rainy season.

20. **Maerua arenaria** Hook. f. & T.

A large woody climber. Rare.

21. **Crataeva religiosa** Forst. f.

A small tree. Fl. April. Rare.

22. **Capparis aphylla** Roth. (Vern. *Ker*)

A much-branched glabrous leafless shrub or tree armed with paired thorns. Fl. March–April and Oct.–Nov. Dominant. Fruit widely preserved as pickle.

23. **C. spinosa** Linn.

A much-branched shrub smaller than *C. aphylla.* Common.

RESEDACEAE

24. **Reseda odorata** Linn.

The garden *Mignonette.* A beautiful plant flowering in cold season.

VIOLACEAE

25. **Viola cinerea** Boiss.

A small greyish perennial herb. Rather rare.

POLYGALACEAE

26. **Polygala erioptera** DC.

An almost erect herb. Fruit with membranous strongly ribbed wings. Occurs on rocky soil in south Pilani. Frequent.

CARYOPHYLLACEAE

27. **Saponaria vaccaria** Linn.

Frequent as a weed in fields. Fl. Feb.–March.

28. **Spergula arvensis** Linn.

A greenish annual with terete fleshy leaves arranged in false whorls. Fl. Jan.–March. Common on moist soil.

29. **S. pentandra** Linn.

Similar to *S. arvensis* and difficult to differentiate. An autecological study of the two might yield as interesting results as obtained by Misra and Siva Rao (1948), Bakshi (1952 *a*) and Pandeya (1953).

30. **Polycarpae corymbosa** Lamk.

An erect herb with silvery flowers arranged in much-branched cymes aggregated into heads. Fl. Aug.–Feb. Frequent on sandy soil.

31. **Dianthus chinensis** Linn.

Rare.

PORTULACACEAE

32. **Portulaca oleracea** Linn. (Vern. *Lunaki*)

A sub-erect annual with fleshy organs. Fl. Aug.–Feb. Abundant.

33. **P. quadrifida** Linn.

A prostrate herb with long stipular hairs. Flowers pinkish and surrounded by silvery hairs. Common on drier soils. Flowers open only for a short duration at noon.

TAMARICACEAE

34. **Tamarix articulata** Vahl. (Syn. *T. aphylla* Lanz.)

A small tree with bi-sexual flowers. Fl. July.

ELATINACEAE

35. **Bergia odorata** Edgew.

An undershrub. Rare. Known for astringent bark.

MALVACEAE

36. **Althea rosea** Linn.

The common hollyhock. Widely cultivated.

37. **Malva verticillata** Linn.

An erect perennial about 3 ft. high. Rare.

38. **Sida veronicaefolia** Lamk.

A perennial trailing herb with yellow flowers. Fl. Aug.–Oct. Frequent.

39. **S. acuta** Burm. (Syn. *S. carpinifolia* Linn. Vern. *Kharenti*).

An undershrub with yellow flowers. Fl. Aug.–Sept. Common.

40. **S. rhombifolia** Linn. var. *rhomboidea* Roxb.

An erect undershrub with flowers collected in leafy corymbs. Flowers open at noon. Common.

41. **S. cordifolia** Linn.

A hairy shrub. Flowers yellow. Fl. Aug.–Nov. Rare.

42. **Abutilon indicum** Sweet.

Occurs as annual. Fl. Aug.–Nov. Rare.

43. **Urena lobata** Linn.

An undershrub with pinkish flowers. Fl. July–Jan. Common in waste places.

44. **Hibiscus gibsoni** Stocks.

An undershrub with purple flowers. Frequent.

45. **H. esculentus** Linn. (Vern. *Bhindi*).

A tall annual covered with brittle hairs. Flowers large yellow with crimson centre. Widely cultivated.

46. **H. rosa-sinensis** Linn.

A shrubby perennial. Cultivated in gardens for its large showy red flowers.

STERCULIACEAE

47. **Waltheria indica** Linn.

A slightly branched pubescent undershrub. Rare.

TILIACEAE

48. **Grewia betulaefolia** Juss. (Syn. *G. populifolia* Vahl.)

A shrub flowering in Aug.–Oct. Fruit edible. Frequent.

49. **Triumfetta rotundifolia** Lamk.

An annual herb with fruits armed with hooks. Fl. Sept.–Oct. Rare.

50. **Corchorus trilocularis** Linn.

An annual herb with 2–3 inch long cylindrical capsules having entire, erect and short beak. Fl. Aug.–Sept. Frequent.

51. **C. tridens** Linn.

An annual herb with 1–2 inch long cylindrical capsules ending in 3 spreading points. Fl. Aug.–Sept. Common.

52. **C. aestuans** Linn. (Syn. *C. acutangulus* Lamk.)

An annual herb with one inch cylindrical winged capsules with 3-fid beak. Fl. Aug.–Sept. Common.

LINACEAE

53. **Linum usitatissimum** Linn. (Vern. *Arsu*)

An erect 2–4 ft. high annual with blue flowers. Cultivated.

ZYGOPHYLLACEAE

54. **Tribulus terrestris** Linn. (Vern. *Bhankri*)

A prostrate herb with yellow flowers perennating by rhizomatous rootstock. Flowers almost throughout the year. Dominant.

55. **Fagonia cretica** Linn. (Vern. *Jowasa*)

A small spiny undershrub with pale rose-coloured flowers. Fl. Sept.–Dec. Common on sand.

56. **Peganum harmala** Linn.

A bush-like herb about 2½ ft. high. Flowers white. Rare.

GERANIACEAE

57. **Monsonia senegalensis** Guill. & Perr.

A diffuse annual with violet flowers. Rare.

58. **Oxalis corniculata** Linn. (Vern. *Khatto*)

A perennial herb with subterranean stems. Flowers yellow. Common.

59. **Tropaeolum majus** Linn.

A garden plant with variously coloured flowers.

RUTACEAE

60. **Murraya exotica** Linn.

A small tree with white flowers. Becomes almost leafless in May–June (cf. Duthie, 1905). Fl. July–Sept. Rare.

61. **M. koenigii** Spreng.

A deciduous shrub with brownish bark. Fl. summer. Leaves used for flavouring curries. Cultivated.

62. **Citrus medica** Linn. (Vern. *Nibboo*)

A small tree with white flowers fruiting throughout the year. Cultivated. Fruit edible and medicinal.

63. **C. aurantium** Linn. (Vern. *Santara*)

A small tree widely cultivated in Chandra Bhawan, Pilani.

SIMARUBACEAE

64. **Balanites aegyptiaca** Delile. (Syn. *B. roxburghii* Planch.)

A small tree with strong sharp thorns. Common in the scrub-jungle surrounding Vidyavihar. The greenish white flowers appear in April–May.

MELIACEAE

65. **Melia azadirachta** Linn. (Syn. *Azadirachta indica* Juss.)

The common Neem tree. White sweet-scented flowers appear in March–April. Frequent.

66. **M. azedarach** Linn (Vern. *Denk*)

Differs from the previous in its bipinnate leaves and the 5-celled drupe. Frequent.

CELASTRACEAE

67. **Celastrus senegalensis** Lamk. (Syn. *Gymnosporia montana* Benth.)

An erect spinous shrub. Fl. Aug.–Oct. Common.

RHAMNACEAE

68. **Zizyphus jujuba** Lamk.

An evergreen armed shrub or a small tree. Fl. Sept.–Nov. Frequent.

69. **Z. rotundifolia** Lamk. (Syn. *Z. nummularia* W. & A.)

A thorny bush flowering in summer. Common.

70. **Z. rugosa** Lamk.

A straggling evergreen shrub, often climbing. Fl. March–April. Very commonly lopped for fodder. Common.

71. **Z. xylopyrus** Willd.

Very similar to *Z. rugosa* but with an almost dry drupe. Fl. April–May. Common.

AMPELIDACEAE

72. **Vitis heyneana** Vahl.

Rather rare.

SAPINDACEAE

73. **Cardiospermum halicacabum** Linn.

An annual climbing herb. Frequent on hedges.

74. **Dodonaea viscosa** Jacq. (Vern. *Vilayati Menhdi*)

An almost evergreen shrub with greenish yellow flowers appearing in Sept.–Feb. Rare.

MORINGACEAE

75. **Moringa pterigosperma** Gaertn.

A small tree with fragrant white flowers. Fl. March. Rare.

LEGUMINOSAE

76. **Crotalaria burhia** Buch.-Ham.

An erect shrub with many slender branches ending in spines. Flowers yellow with reddish veins. Fl. Jan.-March. Common on sandy soil. Exhibits monstrosities like *Farsetia jacquemontii*.

77. **C. medicaginea** Lamk.

A small herb with minute yellow flowers. Rare.

78. **Melilotus indica** All. (Syn. *M. parviflora* Desf.)

A slender annual with yellow flowers. Fl. cold season. Common.

79. **M. alba** Desr.

Similar to the preceding but with white flowers. Frequent.

80. **Trigonella corniculata** Linn.

A sub-erect annual. Rare.

81. **Dolichos lablab** Linn.

An annual with pinkish white flowers. Largely cultivated for the edible pods.

82. **Clitoria ternatea** Linn.

A handsome climber with large beautiful blue or white flowers. Fl. July-Sept. Frequent on hedges.

83. **Canavalia ensiformis** DC.

A large climber with white flowers. Cultivated.

84. **Butea monosperma** (Lamk.) Kuntze. (Syn. *B. frondosa* Roxb.)

A large tree with beautiful flowers. Fl. March-April. Frequent.

85. **Sesbania aegyptiaca** Pers.

A small tree with yellowish flowers. Rather rare.

86. **Tephrosia tenuis** Wall.

An annual with simple leaves. Fl. throughout the year. Frequent.

87. **T. purpurea** Pers.

A copiously branched perennial with pink flowers appearing from June to March. Very common.

88. **T. villosa** Pers.

A small diffuse undershrub flowering in August. Rare.

89. **Indigofera cordifolia** Heyne.

A diffuse annual flowering after rains. Rare.

90. **I. articulata** Gouan. (Syn. *I. argentea*)

An undershrub with reddish yellow flowers. Frequent.

91. **Cicer arietinum** Linn.

A small much-branched annual. Fl. Feb.-March. Cultivated.

92. **Lathyrus aphaca** Linn.

An annual leafless herb with leafy stipules. Fl. winter. Common.

93. **L. sativus** Linn.

Cultivated as a cold weather crop.

94. **Pisum sativum** Linn.

An annual with white flowers. Almost frequent.

95. **Dalbergia sissoo** Roxb.

A large deciduous tree. Common on roadsides.

96. **Alysicarpus monilifer** DC.

A diffuse annual. Common on waste lands.

97. **Alhagi camelorum** Fisch. (Syn. *A. maurorum* W. & A.)

A small spinous shrub with terete branches. The reddish flowers appear in March-April. Common.

98. **Cassia fistula** Linn.

A tree with bright yellow flowers. Fl. summer. Rare.

99. **C. occidentalis** Linn.

An undershrub. Fl. Aug.-Oct. Frequent.

100. **C. sophora** Linn.

A diffuse shrub with yellow flowers. Rare.

101. **C. auriculata** Linn.

A tall shrub with spreading branches. Rare.

102. **Tamarindus indica** Linn. (Vern. *Imli*)

A large handsome tree. Flowers yellow striped with red. Fruit edible. Frequent.

103. **Parkinsonia aculeata** Linn.

A small spiny tree. Rather rare.

104. **Prosopis spicigera** Linn.

A moderate-sized thorny tree. Dominant. With *Capparis aphylla* it forms the climax vegetation in Pilani. Fl. March-May.

105. **P. juliflora** DC.

An Australian plant whose sweet pods are largely used as food and as fodder for cattle. Common.

106. **Mimosa pudica** Linn.

A widely spreading diffuse undershrub with sensitive leaves. Cultivated in the Botanical Garden.

107. **M. hamata** Willd.

A large straggling prickly shrub with armed pods. Fl. July-Sept. Common.

108. **Acacia farnesiana** Willd.

A small tree with about ½ inch long stipular spines. Fl. March-April. Frequent.

109. **A. arabica** Willd.

An evergreen tree with nearly 2 inch long stipular spines. Fl. July-Sept. Frequent.

110. **A. senegal** Willd.

A small tree 10-15 ft. high with small hooked spines in threes. Fl. Sept.-Nov. Common.

111. **A. modesta** Wall.

Similar to previous but with paired stipular spines. Fl. March-April. Common.

112. **Albizzia lebbeck** Benth.

A large deciduous tree with greenish white fragrant flowers. Fl. March-May. Frequent.

ROSACEAE

113. **Rosa damascena** Mill.

The Rose—an undershrub largely grown in the gardens.

COMBRETACEAE

114. **Terminalia arjuna** Bedd. (Syn. *T. glabra* W. & A.)

A large tree with winged fruits. Fl. April-May. Frequent.

115. **Anogeissus pendula** Edgew. (Vern. *Dhaukra*)

A small tree with pendulous branches. Fl. Aug.-Sept. Common.

MYRTACEAE

116. **Eugenia jambolana** Lamk.

A medium-sized tree with white flowers. Fl. March-April. Rare.

117. **Psidium guayava** Linn.

A small tree flowering in Sept.-Oct. and March-April. Cultivated.

LYTHRACEAE

118. **Lawsonia alba** Lamk. (Vern. *Menhdi*)

A shrub about 5-7 ft. high. Rare in wild state but cultivated frequently as a hedge plant.

119. **Punica granatum** Linn.

A shrub with bright red flowers. Fl. April-May. Cultivated.

CUCURBITACEAE

120. **Trichosanthes cucumerina** Linn.

A twining pubescent herb with 2-3 fid tendrils. Fl. Aug.-Sept. Common.

121. **T. anguina** Linn.

Differs from the preceding in the size and shape of the fruit. Fl. Aug.–Sept. Common.

122. **Lagenaria vulgaris** Ser.

A large climbing or trailing herb. Fl. Aug.-Sept. Rare.

123. **Luffa acutangula** Roxb.

An extensively climbing herb. Fl. Aug.-Sept. Frequent.

124. **Momordica charantia** Linn. (Vern. *Kareli*)

Occurs mostly as a trailing much-branched herb. Branches spreading from the centre. Flowers yellow. Fl. Aug.-Sept. Common on open ground.

125. **Cucumis melo** Linn.

An annual with large leaves. Extensively cultivated. Rare as wild.

126. **Coccinia indica** W. & A. (Syn. *Cephalandra indica* Naud.)

An annual or perennial climber with tuberous roots and large white flowers. Fl. Aug.-Sept. Very common.

127. **Cucurbita maxima** Duchesne.

An annual with large rigid leaves having rounded lobes. Rare.

128. **Citrullus vulgaris** Schrad.

An extensively climbing annual with yellowish green flowers. Rather rare.

CACTACEAE

129. **Opuntia dillenii** Haw.

The common cactus. Fl. Sept.-Oct. Common.

FICOIDEAE

130. **Trianthema monogyna** Linn.

A prostrate almost glabrous herb with 15 stamens. Fl. during and after rains. Abundant.

131. **T. crystallina** Vahl.

A minutely papillose herb with elliptic fleshy leaves. Stamens 5. Fl. August-Oct. Common.

132. **T. pentandra** Linn.

Differs from the previous two in having two styles. Fl. Aug.-Oct. Abundant. An ecological study of these three species of *Trianthema* is full of potentialities (see Misra, 1944).

133. **Mollugo hirta** Thunb.

A densely hairy annual. Stems prostrate, spreading from the centre. Fl. March-April. Very common on drying beds of ponds. An interesting plant for autecological studies as done for the two succeeding species (see Bakshi and Kapil, 1953, 1954).

134. **Mollugo cerviana** Ser. (Vern. *Chiria-bajra*)

A glabrous annual with elliptic or nearly terete leaves arising from thick nodes of umbellate filiform branches. Fl. July-Sept. Very common on open sandy soil and sand dunes.

135. **M. nudicaulis** Lamk.

A slender glabrous annual with many leafless stems arising from a tuft of radical leaves. Fl. July-Oct. Very common on moist soil.

136. **Gisekia pharnaceoides** Linn.

A succulent herb with nearly prostrate branches. Fl. July-Oct. Abundant. The plant is strongly anthelmintic.

137. **Unidentified** (Vern. *Tambeshwari*)

An erect much-branched herb with crimson flowers. Fl. Sept.-Oct. Common on a small hillock especially on its top. Rather conspicuously absent in all other localities.

UMBELLIFERAE

138. **Psammogeton biternatum** Edgew.

A small annual with umbels in groups of silvery tufts. Common on moist soil.

The cultivated species of the family include:

139. **Foeniculum vulgare** Mill.

140. **Coriandrum sativum** Linn.

141. **Cuminum cyminum** Linn.

142. **Daucus carota** Linn.

Occasionally these are seen wild too, probably as escapes.

RUBIACEAE

143. **Spermacoce hispida** Linn.

A procumbent herb with white flowers. Frequent.

COMPOSITAE

144. **Vernonia cinerea** Less.

An erect herb with pink or lilac heads. Fl. in winter. Common especially in shady places.

145. **Ageratum conyzoides** Linn.

A hairy annual, 2 ft. high. Flowers bluish. Fl. Jan.-Feb. Common.

146. **Pluchea lanceolata** C. B. Clarke.

A small undershrub with tubular purplish flowers. Fl. cold weather. Frequent on sandy soil.

147. **Gnaphalium luteo-album** Linn. var. **multiceps** Wall.

A woolly annual about a foot high. Heads bright yellow. Rare.

148. **Xanthium strumarium** Linn.

A coarse unarmed annual. Fruit covered with hooked prickles. Fl. Sept.-Oct. Common in waste places.

149. **Eclipta erecta** Linn.

A strigose slender annual with pure white heads. Fl. Aug.-Dec. Common.

150. **Blainvillea latifolia** (Linn. f.) DC. (Syn. *B. rhomboidea* Cass.)

An annual with yellow ray flowers. Fl. Nov.-Feb. Rare.

151. **Glossocardia boswallia** DC. (Syn. *G. linearifolia* Cass.)

A small prostrate annual with yellow heads. Fl. Oct.-Dec. Rare.

152. **Tridax procumbens** Linn.

A straggling herb with long peduncled heads. Fl. throughout the year. Common.

153. **Artemisia scoparia** Waldst. & Kit.

A pubescent herb about 4-5 ft. high perennating by a rootstock. Fl. Sept.-Oct. Rather rare.

154. **Sonchus oleraceus** Linn.

An erect annual, 2-3 ft. high. Heads in umbellate cymes. Fl. March. Common in Agriculture Farm and in waste places.

155. **Launaea nudicaulis** Hook. f.

A perennial with yellow juice. Heads racemose. Fl. Dec.-Feb. Common on cultivated soil.

156. **Helianthus annuus** Linn.

The common sunflower. Largely grown as an ornamental plant. Other cultivated species include:

157. **Cosmos bipinnatus** Cav.

158. **Dahlia variabilis** Desf.

159. **Tagetes erecta** Linn.

160. **T. patula** Linn.

161. **Calendula officinalis** Linn.

162. **Chrysanthemum** sp.

PRIMULACEAE

163. **Anagallis arvensis** Linn. var. **coerulea.**

An erect annual herb with blue flowers. Fl. Jan.-March. Common.

SAPOTACEAE

164. **Mimusops elengi** Linn.

A handsome tree with small fragrant star-shaped flowers appearing in March-April. Rare.

OLEACEAE

165. **Jasminum humile** Linn.

An erect shrub with bright yellow flowers. Cultivated.

166. **Nyctanthes arbor-tristis** Linn.

A small tree with angular stems. Fl. Sept.-Oct. Cultivated.

SALVADORACEAE

167. **Salvadora persica** Linn.

An evergreen shrub or small tree. The greenish yellow pedicelled flowers appear during Jan.-April. Fruit red when ripe. Abundant.

168. **S. oleoides** Dcne.

Differs from the previous species in its sessile flowers and the fruit yellow when ripe. Frequent.

APOCYNACEAE

169. **Carissa carandas** Linn. (Vern. *Karaunda*)

A large shrub with pinkish white flowers. Fl. Jan.-April. Frequent.

170. **Nerium odorum** Soland.

A large evergreen shrub with milky juice. Flowers red or white. Fl. April-June. Common.

171. **Thevetia neriifolia** Juss.

An evergreen small tree with bright yellow flowers. Common.

172. **Vinca rosea** Linn.

A perennial herb with white or pinkish blue flowers. Flowers almost throughout the year. Common.

ASCLEPIADACEAE

173. **Calotropis gigantea** R. Br.

A hoary shrub up to 10 ft. high. Flowers white. Rare.

174. **C. procera** R. Br. (Vern. *Ankdo*)

Similar to the previous sp. but with pink flowers. Fl. March-June. Abundant.

175. **Daemia extensa** R. Br.

A twining perennial foetid herb. Flowers pale yellowish green tinged with pink at the base. Fl. Jan.-April. Frequent.

176. **Leptadenia spartium** Wight.

A much-branched leafless shrub about 2-6 ft. high. Flowers yellow. Fl. Dec-Jan. Abundant.

177. **Ceropegia bulbosa** Roxb.

A twining perennial herb with tuberous rootstock. Flowers greenish on the outside, violet within. Fl. summer. Frequent.

GENTIANACEAE

178. **Canscora diffusa** R. Br.

A slender annual about 2 ft. high. Flowers pink, appearing in Aug.-Oct. Rather rare.

BORAGINACEAE

179. **Cordia myxa** Linn.

A deciduous tree with white flowers. Fl. March-April. Frequent.

180. **C. rothii** Roem.

A smaller tree with opposite leaves. Fl. April-June. Frequent.

181. **Heliotropium eichwaldi** Steud.

An erect herb branching from a woody base. Fl. Nov.-Feb. Common.

182. **H. zeylanicum** Lamk.

A small shrub-like herb with stiff ascending branches. Rare.

183. **H. strigosum** Willd.

A much-branched procumbent herb. Fl. Aug.-Oct. Common.

184. **Trichodesma indicum** R. Br.

An erect hispid herb with pale blue flowers. Fl. Oct.-Dec. Rare.

CONVOLVULACEAE

185. **Cuscuta hyalina** Roth.

A leafless yellowish green parasite. Fl. Sept.-Nov. Rather rare.

186. **Evolvulus alsinoides** Linn.

A much-branched prostrate diffuse herb with white or blue flowers. Fl. July-Nov. Common.

187. **Convolvulus pluricaulis** Chois.

A diffuse hairy perennial herb with a woody rootstock and sub-erect branches. Common on sandy soil.

188. **C. arvensis** Linn.

Differs from the previous species in its trailing or twining habit and 12-inch long peduncled flowers. Fl. cold season. Common.

189. **Merremia hastata** Hallier.

A diffuse twining biennial herb with pale yellow flowers. Fl. Aug.-Dec. Rare.

190. **Ipomoea hederacea** Jacq.

An annual with twining stem. Flowers bluish-pink. Fl. after rains. Frequent.

191. **I. pes-tigridis** Linn.

A twining pubescent herb with capsule enclosed in densely hairy calyx. Corolla falls off within an hour of opening. Fl. Sept.-Oct. Frequent.

192. **I. batatas** Lamk.

The sweet potato. Commonly cultivated.

193. **I. leari** Paxt.

A handsome perennial climber with dark blue flowers turning red on fading. Cultivated in the Botanical Garden.

194. **I. pulchella** Roth.

The Railway Creeper. A perennial climber with pale purple campanulate flowers. Common on hedges.

195. **I. biloba** Forsk.

A perennial twiner with bilobed leaves. Common.

196. **Rivea ornata** Chois.

A large spreading shrub with white fragrant flowers. Fl. Aug.-Oct. Rare.

SOLANACEAE

197. **Solanum nigrum** Linn. (Vern. *Makoi*)

An erect glabrous much-branched annual with angular stems. Flowers white. Fl. cold season. Common on moist soil.

198. **S. xanthocarpum** Schrad.

A prickly bright green perennial herb with bluish purple flowers. Fl. July-April. Common.

199. **Physalis minima** Linn.

An annual, about a foot high. Flowers yellow. Fl. May-Aug. Frequent.

200. **P. peruviana** Linn.

Similar to the preceding but a stouter plant with larger flowers and fruits. Rare.

201. **Withania somnifera** Dunal.

An undershrub up to 5 ft. high with greenish yellow flowers. Berry enclosed in much enlarged inflated calyx. Very common.

202. **Datura fastuosa** Linn.

A coarse shrub-like herb, 4-5 ft. high. Capsule covered with stout tubercles. Abundant on waste ground.

203. **D. alba** Nees.

Similar to the previous species but with capsule covered with sharp spines. Frequent.

204. **Petinia nyctaginiflora** Juss.

An annual about 2 ft. high with dull white or blue flowers. The cultivated species include:

205. **Solanum melongena** Linn.

206. **S. tuberosum** Linn.

207. **Lycopersicum esculentum** Mill.

208. **Capsicum** sp.

SCROPHULARIACEAE

209. **Antirrhinum orontium** Linn.

An erect herb about a foot high. Flowers pink streaked with purple. Fl. cold season. Frequent.

210. **Striga orobanchoides** Benth.

A small puberulous parasitic herb with a tuberous rootstock. Turns black on drying. Fl. Oct. Rare.

OROBANCHACEAE

211. **Cistanche tubulosa** Wight.

A yellowish plant tinged with purple. Yellow flowers arranged in dense spikes. Fl. cold season. Rare.

BIGNONIACEAE

212. **Tecomella undulata** Seem.

A tree, 15–25 ft. tall with drooping branches. The large flowers are orange yellow. Fl. March-April. Common.

PEDALIACEAE

213. **Sesamum indicum** Linn.

An erect annual about 2 ft. high. Flowers large, pinkish-purple spotted with yellow. Fl. Sept.-Oct. Common.

214. **Martynia diandra** Glox.

An erect annual herb with beautiful rose-coloured flowers. Fruit with two hard curved spines. Fl. Sept.-Oct. Rather rare.

ACANTHACEAE

215. **Tubiflora acaulis** O. Kuntze (Syn. *Elytraria crenata* Vahl.)

A small herb with compressed stem and rosette of radical, obovate crenate, 3-8 inch long leaves lying flat on the ground. Scapes many, usually longer than the leaves clothed with bract-like scales. Flowers pale blue on a 3 inch long narrow spike covered with spirally imbricate stiff bracts. Fl, Sept.-Oct. An important plant ecologically. Very common in shade on the slopes of the temporary pond studied by Ratnam and Joshi (1952) who, however, have not recorded it.

216. **Blepharis boerhaaviaefolia** Pers. (Syn. *Acanthus maderaspatanus* Linn.)

A prostrate roughly pubescent herb with blue flowers. Fl. in the cold season. Not rare. Usually inhabits drier localities.

217. **Adhatoda vasica** Nees. (Syn. *Justicia adhatoda* Linn.)

A dense evergreen shrub about 4-6 ft. high. Flowers white with pink or purple stripes. Fl. after rains and in March-April. Not infrequent.

218. **Lepidagathis trinervis** Nees.

A diffuse perennial herb with white flowers spotted with brown dots. Fl. cold season. Frequent on sandy soil.

219. **Justicia quinqueangularis** Koen.

A slender nearly prostrate herb with linear obtuse bracteoles. The rosy flowers appear after rains. Common.

220. **J. diffusa** Willd.

A diffuse herb with lanceolate acute bracteoles and glabrous sepals. Flowers pink. Fl. after rains. Common.

221. **J. simplex** D. Don.

Similar to the previous species but with hairy sepals. Fl. winter. Common.

VERBENACEAE

222. **Lantana indica** Roxb.

A stout shrub 3-8 ft. high with yellowish flowers arranged in axillary heads. Frequent. A troublesome weed in some places.

223. **Clerodendron phlomidis** Linn.

A large shrub with white or pink flowers. Fl. March-May. Frequent.

224. **Stachytarpheta indica** Vahl.

A short glabrous herb with dark blue flowers. Frequent.

225. **Duranta plumieri** Jacq.

An erect spinose shrub with bluish-white flowers; berries orange. Common.

LABIATAE

226. **Ocimum sanctum** Linn.

An undershrub with pink flowers. Fl. Jan.-March. Frequent.

227. **Leucas aspera** Spreng.

An annual about a foot high. Flowers white. Fl. Feb.-March. Rare.

228. **Leonotis nepetaefolia** R. Br.

A tall annual with scarlet flowers. Fl. Sept.-Oct. Frequent.

229. **Salvia aegyptiaca** Linn.

A low much-branched straggling undershrub. Rare.

In addition species of *Mentha* are cultivated in the Agriculture Farm.

NYCTAGINACEAE

230. **Boerhaavia diffusa** Linn. (Syn. *B. repans* Linn.)

A diffuse branched herb, branches ascending. Leaves of each pair unequal. Flowers pink and subcapitate. Fl. July-Sept. Very common.

231. **B. repanda** Willd.

Similar to *B. diffusa* but, according to Duthie (1915), with leaves of each pair equal. However, this differentiating character does not appear to be stable in Pilani, and paired leaves of all the possible sizes and size-differences are frequent. An autecological study may be helpful.

232. **Mirabilis jalapa** Linn.

A tall much-branched perennial herb with crimson flowers. Rare.

233. **Bougainvillea spectabilis** Willd.

A robust thorny climbing shrub. Bears masses of flowers during the hot season and becomes conspicuously beautiful due to its brilliant purple bracts. Common in gardens.

AMARANTACEAE

234. **Celosia argentea** Linn.

An erect glabrous annual about 3 ft. high. Flowers pink when young, becoming white and glistening, forming cylindrical terminal spikes. Fl. Sept.-Oct. Rare weed of fields.

235. **C. cristata** Linn.

Similar to *C. argentēa* but is taller, has broader leaves and smaller crimson flowers arranged in beautiful spikes. Common.

236. **Digera arvensis** Forsk.

An annual herb with pink flowers. There are two dichasium-like branched scales, each in the axil of a bracteole. Each scale has been regarded as a reduced flower by earlier authors (Hooker, 1885; Duthie, 1915; Joshi and Rao, 1934), but Bakshi and Chhajlani (1953, 1954) regard it as a reduced inflorescence. Fl. Aug.-Oct. A common weed of waste land.

237. **Amarantus spinosus** Linn.

An erect spinous herb with greenish flowers arranged in ermina l and axillary spikes. Fruit dehiscent. Fl. Aug.-Oct. Common.

238. **A. paniculatus** Linn.

A robust annual, 4-7 ft. high, unarmed. Fl. Nov.-March. Frequent.

239. **A. viridis** Linn.

An erect glabrous annual about 2 ft. high. Fl. Sept.-March. Fruit with an acute apex, indehiscent. Frequent.

240. **A. blitum** Linn.

A glabrous procumbent annual. Fruit broadly ovate, indehiscent. Common.

241. **Aerua tomentosa** Forsk. (Syn. *A. javanica* Wight.)

A hoary tomentose erect undershrub with spikes, both axillary and terminal. Flowers deciduous or hermaphrodite. Fl. Aug.-Sept. Abundant on open ground.

242. **A. lanata** Juss.

An erect undershrub. Spikes axillary. Silvery white flowers may be uni- or bi-sexual. Fl. Sept.-Oct. Rather rare.

243. **Achyranthes aspera** Linn.

A coarse weed of moist soils. Flowers greenish white, sharply deflexing soon after pollination. Fl. April-July. Frequent.

244. **Pupalia lappacea** Juss.

A large straggling tomentose undershrub. Flowers in clusters in terminal spikes. Each cluster with one central fertile and two or more lateral sterile flowers reduced usually to hooked awns. Fl. Sept.-Nov. Very common in bushes.

245. **Alternanthera sessilis** R. Br.

A prostrate herb. Flowers in axillary sessile heads. Frequent.

246. **A. pungens** H. B. K.

A prostrate weed very similar to *A. sessilis.* The distinguishing characters of the two are not clearcut. Further work on the morphology and ecology is, therefore, suggested. See also Raizada (1950).

247. **Gomphrena globosa** Linn.

An erect much-branched sub-silky annual with crimson flowers arranged into globose heads. Fl. Sept.-Nov. Common.

248. **G. celosiodes** Mart.

A prostrate much-branched herb with greenish cylindrical heads. Fl. Sept.-Nov. Rare.

For the detailed morphology of the flower and the inflorescence, as also for the early history of the family, reference may be made to Bakshi (1952*b*), and Bakshi and Chhajlani (1953, 1954).

CHENOPODIACEAE

249. **Chenopodium album** Linn.

A tall scentless herb with smooth shining seeds. Fl. Jan.-April. Abundant.

250. **C. murale** Linn.

A low rather foetid herb with rugose dull black seeds. Fl. March-May. Rather rare.

251. **Kochia indica** Wight.

An erect annual branching from the base. Fruiting perianth with transverse wings. Common, especially in gardens.

The cultivated species of the family include :

252. **Beta vulgaris** Linn.

253. **Spinacia oleracea** Linn.

POLYGONACEAE

254. **Polygonum plebejum** R. Br.

A prostrate diffusely branched herb with a woody rootstock. Flowers pink. Fl. March-May. Common on drying beds of ponds.

255. **Rumex hastatus** Don.

A glaucous herb with pink flowers due to the inner bright sepals which are delicately veined. Fl. late in winter. Frequent.

256. **Calligonum polygonoides** Linn.

A leafless shrub or small tree During the hot season the bushes are covered with the fragrant pinkish flowers. Frequent.

ARISTOLOCHIACEAE

257. **Aristolochia bracteata** Retz.

A slender decumbent glabrous perennial herb with purple flowers. Fl. Sept.-Oct. Frequent.

EUPHORBIACEAE

258. **Euphorbia royleana** Boiss.

An erect glabrous fleshy cactus-like shrub up to 12 ft. high. Fl. hot season. I observed only a couple of plants on the outskirts of Pilani.

259. **E. neriifolia** Linn.

An erect glabrous shrub or small tree about 15 ft. high with 4-8 inch long fleshy leaves. Fl. hot season. Frequent.

260. **E. hirta** Linn.

A hairy annual with ascending stems about 1½ ft. high. Fl. almost throughout the year. Common.

261. **E. thymifolia** Linn.

A small prostrate annual with a coppery tinge. Branches hairy, 4-8 inches long. Fl. during most of the months. A conspicuous garden weed.

262. **E. microphylla** Heyne.

Similar to *E. thymifolia* but with smooth branches. A garden weed.

263. **E. clarkeana** Hook. f.

Differs from the previous species in its rugose seeds. A much more copiously branched herb. Frequent on moist soils in rainy season.

264. **E. splendens** Boj.

A small very prickly and much-branched shrub with crimson flowers. Cultivated in the gardens.

265. **Phyllanthus maderaspatensis** Linn.

A glabrous herb with axillary flowers. Fl. after rains. Frequent.

266. **P. niruri** Linn.

A common garden weed.

267. **Ricinus communis** Linn.

The Castor-oil plant. Frequent.

URTICACEAE

268. **Morus alba** Linn.

The mulberry tree. Fl. Feb.–March. Frequently cultivated.

269. **Ficus bengalensis** Linn.

The Banyan tree. Very rare.

270. **F. religiosa** Linn.

The Pipal tree. Frequent.

HYDROCHARITACEAE

271. **Hydrilla verticillata** Royle

A submerged leafy freshwater herb. Cultivated in the Botanical Garden.

SCITAMINACEAE

272. **Canna indica** Linn.

A stout herb with a tuberous rootstock. Common.

AMARYLLIDACEAE

273. **Agave vera-cruz** Miller

A perennial with many leaves arising from a stout trunk. Common.

LILIACEAE

274. **Asparagus adscendens** Roxb.

A sub-erect shrub with cladodes in dense tufts of 6-20. Cultivated in Botanical Garden.

275. **Asphodelus tenuifolius** Cav. (Vern. *Piazi*)

An annual about 1-2 ft. high with 6-12 inch long terete leaves. Flowers white. Fl. Jan.-March. Abundant in fields.

The cultivated species include :

276. **Allium cepa** Linn.

277. **A. sativum** Linn.

COMMELINACEAE

278. **Commelina nudiflora** Linn.

A diffuse glabrous herb with lanceolate leaves and dark blue flowers. Fl. Aug.-Sept. Common.

279. **C. benghalensis** Linn.

Similar to the previous species but with elliptic leaves. Frequent.

280. **C. obliqua** Buch.-Ham.

A tall branching herb with long leaves. Fl. Aug.-Sept. Rare.

CYPERACEAE

281. **Cyperus difformis** Linn.

An erect annual glabrous herb, a foot high, inflorescence of 3-6 compact heads. Common especially in Agriculture Farm.

282. **C. niveus** Retz.

A perennial erect glabrous herb with a bulb-like stem. Heads of 3-13 spikelets. Rather frequent.

283. **C. rotundus** Linn.

A variable herb with an underground rhizome. Inflorescence an umbel of condensed spikes. Fl. Sept.-Oct. Common.

284. **Fimbristylis dichotoma** Vahl.

A tufted herb about a foot high. Spikelets almost in compound umbels. Rather rare.

GRAMINEAE

With the exception of the species of *Cenchrus* which are abundant, the rest of the grasses can be said to be common. The majority of them, though annuals, perennate by underground organs. Almost all of them flower after rains.

285. **Heteropogon contortus** Beauv. ex Roem & Schult. (Syn. *Andropogon contortus* Linn.)

286. **Digitaria marginata** Link. (Syn. *Paspalum sanguinale* Lamk.)

287. **Setaria verticillata** Beauv.

288. **Panicum crus-galli**

289. **Cenchrus ciliaris** Linn. (Syn. *Pennisetum cenchroides* Rich.)

290. **C. setigerus** Vahl. (Syn. *C. biflorus* Roxb.)

291. **Aristida hystrix** Linn. f.

292. **Perotis indica** O. Kuntze (Syn. *P. latifolia* Ait.)

293. **Eragrostis plumosa**

294. **E. viscosa** Wight

295. **E. nutans** Nees. (Syn. *E. stenophylla* Hochst.)

296. **Chloris virgata** Sw.

297. **Eleusine verticillata** Roxb.

298. **Dactyloctenium aegyptium** Beauv. (Syn. *Eleusine aegyptiaca* Desf.)

299. **Echinochloa crus-galli**

300. **Dichanthium annulatum** Stapf. (Syn. *Andropogon annulatus* Forsk.)

301. **Dichanthium caricosum** A. Camus (Syn. *Andropogon caricosus* Linn.)

For the detailed morphology and ecology of these species of *Dichanthium* reference may be made to Pandeya (1953).

The cultivated plants include species of the following :

302. **Triticum**

303. **Hordeum**

304. **Avena**

305. **Zea**

306. **Sorghum**

307. **Pennisetum**

308. **Andropogon**

309. **Saccharum**

CONIFERAE

310. **Thuja orientalis** Linn.

A small evergreen tree. Cultivated in gardens.

311. **Araucaria cunninghamii** Ait.

Also cultivated in gardens.

GNETACEAE

312. **Ephedra foliata** Boiss. var. **ciliata** (C.A. Mey) Stapf.

A xerophytic plant with leafless fascicled stem. Usually found on *Capparis aphylla*, *Prosopis spicigera*, *Calligonum polygonoides*, etc. Fl. Nov.-March. Common.

SUMMARY

Since the publication of the pioneer work of Blatter and Hallberg—The Flora of the Indian Desert—the study of the Rajputana Desert vegetation received scant attention almost till 1950 when a few authors tried to revive interest in the subject by preparing lists of plants occurring in their neighbourhood. The present paper is a detailed account of the vegetation of Pilani and its neighbourhood comprising an area of about 40 square miles. Pilani, originally a small village in the Jaipur State but now an important educational centre of India, is situated a little over 100 miles to the west of Delhi.

Pilani receives an average annual rainfall of about 14 inches. The percentage of relative humidity is low, the hot or cold winds nearly constant, and the temperatures extreme. The chemical nature of the almost dry sandy soil is characteristic. The carbonate content is very low, the nitrates are in plenty, and the reductivity is usually 1. The pH value ranges from 7 to 8·5. The sand dunes are of the *Barchan* type.

The vegetation is distributed into discontinuous patches giving the region the appearance of a scrub jungle. A large number of plants exhibit xerophytic characters. These include the reduction of the transpiring surface, production of epidermal outgrowths, presence of thorns, spines and prickles, development of phylloclades, formation of long roots, and perennation by underground organs.

The entire vegetation can be divided into distinct groups: those depending directly on rain for their water supply, and those drawing water from the deeper layers of the soil. There is also an important group of plants which are annuals apparently but which vegetate during the unfavourable season by some underground parts. These include plants like *Tribulus terrestris* Linn., *Polygonum plebejum* R. Br., and others. The commonest and the most successful annuals belong to the families Capparidaceae, Zygophyllaceae, Leguminosae, Cucurbitaceae,

Ficoideae, Compositae, Convolvulaceae, Nyctaginaceae, Amarantaceae, Chenopodiaceae, Euphorbiaceae, Commelinaceae and Gramineae. Some of the more common and dominant plants of the Upper Gangetic Plain on the one hand and the Punjab and the West Rajasthan on the other are found flourishing in Pilani. This gives weight to the suggestion by the earlier authors that the vegetation of the Upper Gangetic Plain is continuous with the dry forests of Rajputana and Punjab.

The vegetation of different patches is not sufficiently stable to give a definite idea of the prevailing plant communities. A few associations, however, appear to be fairly constant.

The list of collections made during 1950–52 comprises 312 species belonging to 70 families. On the basis of the number of species the predominant families are: Leguminosae (39), Gramineae (25), Compositae (19), Amarantaceae (15), Convolvulaceae (12), Solanaceae (11), Euphorbiaceae (10), Cucurbitaceae and Cruciferae (9 each), and Ficoideae (8). The families Cyperaceae, Boraginaceae, Acanthaceae and Malvaceae are rather poorly represented in Pilani and its adjacent areas in comparison to the rest of the Rajputana Desert. Some of the possible avenues of further research and exploration have been suggested.

Acknowledgements

It gives me great pleasure to express my heartfelt thanks to my former students at the Birla College, Pilani, for the help rendered in various ways during the course of the present study. Specific mention in this respect may be made of Mr. B. D. Deshpande (now Research Scholar at Pilani), Mr. D. N. Misra Raj (now Lecturer in Botany, Holkar College, Indore), Mr. M. C. Joshi (now Assistant Professor of Botany, Birla College, Pilani), and Mr. N. C. Nair (now a member of the teaching staff at Pilani). To my former colleague, Mr. Pat Ram Gaur (Department of Sanskrit, Birla College, Pilani), I am indebted for creating in me a deep interest for studying the *living* plants rather than the preserved laboratory or herbarium specimens. I am grateful to the Rev. H. Santapau, S.J. (St. Xavier's College, Bombay) for kindly going through the manuscript and for making valuable suggestions. Thanks are due to Jaswant Bakshi, my wife, who frequently accompanied me in the field, for being more than a mere onlooker by substantially contributing to the collections.

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POISONOUS SEEDS OF INDIA

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PART II

(*Continued from page* 105 *of this volume*)

56. **Lathyrus aphaca** Linn. (Leguminosae).

English names.—Yellow-flowered Pea; Yellow Vetchling.

Indian names.—Be. & Hi. *Janglimatar*; Pun. *Rawari.*

Distribution.—An annual herb found in the Punjab, Uttar Pradesh, Bengal and Madhya Bharat, ascending to an altitude of 7,000 ft. on the Western Himalayas.

Constituents of the seeds.—According to Pammel (24) the plant contains hydrocyanic acid, but the author does not find any original reference for this statement.

Remarks.—It is used in many localities as fodder for cattle. According to Voigt, the ripe seeds are narcotic, their effect being noticeable when eaten abundantly; in the young state, however, they are perfectly harmless (7). The plant has been regarded as one of the possible causes of a disease called lathyrism.

57. **Lathyrus sativus** Linn. (Leguminosae).

English names.—Chickling Vetch, White Vetch.

Indian names.—Be. & Hi. *Khesari*; Mar. *Lakh*; Sans. *Sandika.*

Distribution.—A pretty annual with winged stems largely cultivated in many parts of India up to an altitude of 4,000 ft. in the Himalayas.

Constituents of the seeds.—Seeds said to contain about 1 per cent of a powerful and dangerously cathartic oil (7).

Remarks.—The plant is largely used as a fodder, and being cheap, the seeds are considerably used as food by the poorer classes of people, especially in times of famine. The seeds as well as the whole plant produce under certain circumstances, in man and animals, a disease called lathyrism.

58. **Linum usitatissimum** Linn. (Linaceae).

English names.—Common Flax, Flax.

Indian names.—Be. *Tisi*; Bo. *Alasi*; Hi. *Alsi*; Sans. & Tel. *Atasi*; Tam. *Alshi.*

Distribution.—An annual herb much cultivated throughout India up to an altitude of 6,000 ft. for the sake of its oil-yielding seeds.

Constituents of the seeds.—Seeds contain a cyanogenetic glucoside, phaseolunatin (linamarin), which is also said to occur in other parts of the plant, such as the leaves, stems and roots (11).

Remarks.—It is said that the immature seeds contain more of the glucoside than the mature ones and that poisoning with the seeds is mainly due to the presence of immature seeds in the material fed. The feeding of linseed cakes to sheep at the rate of 150 gm. daily and the increase of this amount to 300 gm. daily after fourteen days caused one death on the second day of feeding; from the twenty-first day onwards a number of animals died (6). Samples of linseed cake were found to furnish 0.032 to 0.045 per cent of hydrocyanic acid (78). Quentin considers that linseed cakes containing more than 0.08 gm. of hydrocyanic acid per kilogram are dangerous (79).

59. **Lobelia nicotianaefolia** Heyne (Lobeliaceae).

English name.—Wild Tobacco.

Indian names.—Be. & Hi. *Nala*; Bo. *Dhaval*; Mal. *Kattupukayila*; Sans. *Devanala*; Tam. *Kattuppugaiyilai*; Tel. Adavipogaku.

Distribution.—A biennial or perennial herb found on the Western Ghats from Bombay to Travancore at altitudes of 3,000 to 7,000 ft. above the sea level and is met with in Konkan, the Deccan, the Nilgiris, Malabar, etc.

Constituents of the seeds.—According to Lisboa quoted by Watt (7) the seeds contain an acronarcotic poison.

Remarks.—The seeds are said to be preferred to Datura as a poison, when rapid effect is desired. Ten to fifteen grains of the powdered seeds will act as a powerful emetic and the symptoms of poisoning are similar to those with nicotine.

60. **Luffa acutangula** (Linn.) Roxb. (Cucurbitacae)

Indian names.—Be., Bo. & Hi. *Jinga*; Sans. *Jhingaka*; Tam. *Pikunkai*; Tel. *Burkai.*

Distribution.—A climber cultivated throughout the greater part of India for its unripe fruits which are largely eaten as a vegetable.

Constituents of the seeds.—The seeds contain a purgative oil luffa-seed oil (11). Seeds contain 20 per cent of a saponin glycoside, an enzyme, and a fixed oil (125).

Remarks.—The seeds are described to be emetic and purgative. The pressed cake from the seeds is bitter and toxic. Doses of 5 to 12 cc. of the oil cause, in dogs, purgation, vomiting and bleeding from the intestines. An alcoholic extract of the seeds is lethal to dogs.

61. **Luffa cylindrica** (Linn.) M. Roem. syn. *L. aegyptiaca* Mill.

English names.—Sponge Gourd, Gourd Towel.

Indian names.—Be. *Dhundal*; Bo. *Gonsali*; Hi. *Ghiatarui*; Sans. *Ghoshaka*; Tam. *Pikku*; Tel. *Nunebira.*

Distribution.—An extensive climber found cultivated or naturalized in most hot countries of the world. In India, it is common everywhere and is often cultivated, especially in the plains.

Remarks.—The seeds are considered in Indian literature to have emetic and cathartic properties.

62. **Madhuca indica** J. F. Gmel. syn. *M. latifolia* (Roxb.) Macbride; *Bassia latifolia* Roxb. (Sapotaceae).

English names.—Butter Tree, Mahua Tree.

Indian names.—Be. *Mahwa*; Bo. & Hi. *Mahua*; Sans. *Madhuka*; Tam. *Madugam*; Tel. *Madhukamu.*

Distribution.—A large deciduous tree found in Oudh, Bihar, Madhya Pradesh, Madhya Bharat, Gujerat, Konkan, North Kanara, Southern Mahratta Country and the Deccan. Largely planted elsewhere and liable to run wild.

Constituents of the seeds.—Seeds contain a neutral saponin (80). Leaves contain a glucosidic saponin and traces of an alkaloid (81).

Remarks.—The residual cake 'mowrah meal' after the extraction of the oil from the seeds is said to be used to poison fish. The smoke produced during the burning of the oil cake is reported to kill insects. The oil cake is used as a worm-killer for lawns—4 oz. per sq. yd. (82).

63. **Madhuca longifolia** (Linn.) Macbride syn. *Bassia longifolia* Linn. (Sapotaceae).

English names.—Honey Tree, Mahua of Southern India.

Indian names.—Be. *Mohuva*; Bo. *Mohwa*; Hi. *Mohua*; Sans. *Madhuka*; Tam. *Mavagam*; Tel. *Pinnayippa.*

Distribution.—A large tree found in the forests of Western India from Konkan southwards to Travancore; common in Malabar, Mysore, Anamalais and the Circars at low elevations.

Constituents of the seeds.—After extraction of the oil from seeds, a sopoglucoside called mowrin is obtained from the residue.

Remarks.—The residual cake 'mowrah meal' after the extraction of oil from the seeds is said to be used to poison fish and as a worm-killer for lawns (82).

64. **Malus sylvestris** Mill. syn. *Pyrus malus* Linn. (Rosaceae).

English names.—Apple Tree, Crab Apple.

Indian names.—Be. & Hi. *Seb*; San. *Seba.*

Distribution.— A tree found wild in the North-western Himalayas. Largely cultivated in the Himalayas, the Punjab, Madhya Bharat and the Deccan.

Constituents of the seeds.—The seed kernels have been shown to contain amygdalin (83). The seeds contain glucoside phlorizin, up to 8 per cent of fresh weight (84).

65. **Melia azedarach** Linn. (Meliaceae).

English names.—Indian Lilac, Pride-of-India.

Indian names.—Be. *Ghorinim*; Bo. & Hi. *Drek*; Sans. *Mahanimba*; Tam. *Malaivembu*; Tel. *Vettiveppa.*

Distribution.—A moderate sized tree commonly cultivated in India but is wild in the sub-Himalayan tract at altitudes of 2,000 to 3,000 ft. above sea level.

Constituents of the seeds.—Seeds contain about 40 per cent of an oil (85).

Remarks.—Seeds possess properties similar to those of *Azadirachta indica* A. Juss. In addition, narcotic symptoms are also produced.

66. **Melilotus officinalis** Lam. (Leguminosae).

English names.—Hart's Clover, Melilot.

Indian names.—Be. *Baupiring*; Hi. *Aspurk*; Pers. *Zirir.*

Distribution.—A biennial herb with yellow flowers found in Nubra and Ladakh at altitudes of 10,000 to 13,000 ft.; cultivated in Europe as fodder.

Constituents of the seeds.—Contains coumarin, a volatile odoriferous principle, which in excess produces a disinclination to locomotion, paralysis and ultimately fatal symptoms. No harm is to be apprehended if the amount present does not exceed 10 per cent of the herbage (6).

Remarks.—Frohner reports that according to Correy and Collas the seeds of *M. officinalis* are poisonous. Horses which received '2-3 litres of the seed' daily developed paralysis of the body musculature, death occurring after ten to twelve days. Autopsy revealed pronounced hyperaemia of the lungs and swelling of the liver (86).

67. **Mundulea sericea** (Willd.) Greenway syn. *M. suberosa* Benth. (Leguminosae).

Indian names.—Deccan *Supti*; Mal. *Kattutuvara*; Tam. *Piralavaram*; Tel. *Palasaram.*

Distribution.—A stout herb or a small tree found in Western and Southern India in Konkan, the Circars, the Deccan and Carnatic to Tinnevelly, in dry forests on rocky hills and up to 4,000 ft. above sea level.

Remarks.—The seeds are used for poisoning fish in Southern and Western India.

68. **Myristica fragrans** Houtt. (Myristicaceae).

English names.—Mace Tree, Nutmeg, True Nutmeg.

Indian names.—Hi. *Jaiphal*; Mal., Sans. & Tel. *Jati*; Tam. *Sivagaram.*

Distribution.—A lofty tree, native of Eastern Moluccas and cultivated more or less throughout Malaya. In India it is only found as a specimen tree in a few localities, where the climate is sufficiently hot and moist, chiefly Botanic Gardens.

Constituents of the seeds.—Nutmegs yield an essential oil and a fixed oil; they also contain a saponin (87). The essential oil, which is present to the extent of about 7 per cent, is colourless or pale yellow, pungent and smells strongly of nutmeg. It was studied by Power & Salaway (88) who, besides other constituents, found about 4 per cent of myristicin. Mace contains about 8 per cent of a volatile oil of yellowish colour and contains myristicin (89). The leaves and bark also contain an essential oil (11).

Remarks.—Cases of poisoning due to nutmeg have occasionally occurred. In man, severe symptoms have been produced from taking one to one and a half nutmegs, or from a teaspoonful of powdered mace. The effects appear in one to six hours and consists mainly of narcosis, varied by excitement and delirium, with signs of stimulation of motor functions and local irritation; they usually end in recovery in twenty-four hours. Nutmeg has also ecbolic properties. Similar toxic effects have also been observed in animals (90).

69. **Myristica malabarica** Lam. (Myristicaceae).

English name.—False Nutmeg.

Indian names.—Bo. *Rampatri*; Mal. *Kattujattika*; Sans. *Kamuka*; Tam. *Pattiri*; Tel. *Adavijajikaya.*

Distribution.—A tree found in the evergreen forests of Konkan, Kanara and Malabar at low levels up to 1,000 ft. altitude.

Constituents of the seeds.—Seeds yield about 0.67 per cent of an essential oil (91).

Remarks.—Narcotic effects are produced in the same way as in *M. fragrans.*

Mill. syn. *N. odorum* Soland. (Apocynaceae).

English names.—Indian Oleander, Oleander.

Indian names.—Be. *Karabi*; Bo. & Hi. *Kaner*; Sans. *Karavira*; Tam. *Kanaviram*; Tel. *Gannera.*

Distribution.—A large glabrous evergreen shrub found in the Himalayas from Kashmir to Nepal up to an altitude of 6,500 ft., and also in Madhya Bharat. Cultivated in gardens throughout India and is apparently wild in South India and in the Bombay State along the banks of streams.

Constituents of the seeds.—Roots, bark and seeds contain the toxic principles neriodorin, neriodorein and karabin (92, 93, 94).

Remarks.—The seeds are highly poisonous and the Mundas use them to poison pigs and jackals though it is the roots that are commonly employed for a variety of criminal purposes. Like neriodorin, karabin is a powerful cardiac poison, acting on the heart in a somewhat similar manner to digitalin and it also acts on the spinal cord in more or less the same way as strychnine (94).

71. **Nigella sativa** Linn. (Ranunculaceae).

English names.—Black Cumin, Small Fennel.

Indian names.—Be. *Kalijira*; Bo. & Hi. *Kalonji*; Sans. *Kalajaji*; Tam. *Karunjiragam*; Tel. *Nullajilakara.*

Distribution.—A pretty herb 1-2 ft. high extensively cultivated in many parts of India for its seeds.

Constituents of the seeds.—The seeds are stated to contain 0.5 to 1.4 per cent of an essential oil and a saponin like glucoside, melanthin. Seeds contain variable amount of saponin (95) and yield melanthigenin (96). An amorphous compound giving reactions of saponin isolated (97).

Remarks.—The seeds have a strong, pungent aromatic taste. It appears to be a common practice in this country to scatter the seeds between the folds of linen or woollen clothes in order to prevent them from being eaten by insects. The seeds are used as emmenagogue in Europe and in large doses produce abortion (7).

72. **Paeonia emodi** Wall. (Ranunculaceae).

English name.—Himalayan Peony.

Indian names.—Hi. *Udsalap*; Kash. *Mid*; Pun. *Mamekh.*

Distribution.—A stout glabrous perennial 1-2 ft. high found in the West Temperate Himalayas from Hazara to Kumaon at altitudes of 5,000 to 10,000 ft. It forms lovely gregarious patches in Kagan and Kashmir and, when in flower in spring, is most beautiful to look at.

Constituents of the seeds.—A poisonous alkaloid has been reported from the seeds and roots of *P. officinalis* Linn. which is a foreign plant (98). It is quite likely that the Indian species has similar poisonous principles.

Remarks.—The seeds are emetic and cathartic.

73. **Papaver rhoeas** Linn. (Papaveraceae).

English names.—Scarlet Poppy, Corn Poppy.

Indian names.—Be. & Hi. *Lal post*; Bo. *Janglimudrika*; Sans. *Raktapostavrikshaha*; Tam. *Siguppuppostaka*; Tel. *Errapostakaya.*

Distribution.—An erect, branched, hispid annual met with in Kashmir and Pangi, but is frequently cultivated in gardens throughout the plains of Northern India.

Constituents of the seeds.—The seed capsules are said to contain morphine, paramorphine and narcotine in addition to rhoeadine (99).

Remarks.—Seeds contain a yellow oil with acrid properties.

74. **Peganum harmala** Linn. (Rutaceae).

English names.—Harmal, Wild Rue.

Indian names.—Be. *Isband*; Bo. *Hurmal*; Hi. *Harmal*; Tam. *Simaiyaravandi*; Tel. *Simagoronti.*

Distribution.—A densely foliaged bushy herb, common in the drier waste places and fields of Baluchistan, Waziristan, Kurrum Valley, Sind, Cutch, Punjab, Kashmir, Delhi, Uttar Pradesh, Bihar, Konkan and the Western Deccan.

Constituents of the seeds.—Seeds contain the alkaloids harmine, hermaline, harmalol and peganine (100); also a soft resin (7).

Remarks.—Seeds are considered narcotic, nauseant, emetic and emmenagogue. In an elephant they are said to bring about a condition of tremendous excitement wherein the animal loses control over himself, i.e. becomes 'mast'. Gopal as quoted by Watt (7) found that an infusion or tincture acted as a mild emmenagogue and produced slight intoxication in the same way as *Cannabis sativa* Linn. He reported that the plant was sometimes employed by Indian midwives to procure abortion and believed that the drug has properties similar to those of ergot, savine and rue.

75. **Pithecellobium bigeminum** Mart. syn. *Pithecolobium bigeminum* Benth. (Leguminosae).

Indian names.—Bo. & Hi. *Kachlora*; Lep. *Tikpikung*; Mal. *Varikiri*; Sans. *Aragvadha*; Tam. *Kalaippakku.*

Distribution.—A middle-sized unarmed tree found in the Eastern Himalayas, Khasia and Jaintia Hills, Konkan, North and South

Kanara, the Western Ghats of the Madras State from Mysore to Anamalais and Travancore, ascending to an altitude of 3,000 ft. above sea level.

Remarks.—The seeds are in great demand in certain parts of Burma where the people use them as a condiment after repeatedly boiling them in water and discarding the water every time. Creais (101) refers to the alarming symptoms that are sometimes produced. Usually there is vomiting with abdominal pain. If uncooked seeds are eaten, violent and persistent vomiting may prevent further symptoms from arising. The urine is suppressed and there is severe pain over the loins and the bladder. Strangury occurs with the passage of a few drops of urine which is often blood tinged. Later when the flow of urine occurs there may be free haematuria. Headache and giddiness are present; the vision is blurred and the conjunctivae are suffused; muscular cramps occur, particularly in the extremities. The symptoms generally set in quickly and are very severe. The poisoning from the seeds causes death of the unborn child.

76. **Plesmonium margaritiferum** (Roxb.) Schott (Araceae).

Distribution.—A tuberous herb found in Central and Eastern Bengal, Chota Nagpur, Singbhum, Ranchi and Manbhum. Very common in the open forest land at Purneah. In the Madras State it is reported from the districts of Vizagapatam and in Rampa hills at an altitude of 1,500 ft.

Remarks.—The crushed seeds have the property of benumbing the nerves (17).

77. **Polygonum aviculare** Linn. (Polygonaceae).

English name.—Bloodwort.

Indian names.—Be. *Machutie*; Hi. *Machoti*; Pun. *Banduke*; Sans. *Miromati.*

Distribution.—A glabrous herb found in the Western Himalayas from Kashmir to Kumaon at altitudes of 6,000 to 10,000 ft.; also in Western Tibet at altitudes of 10,000 to 12,000 ft.

Remarks.—Seeds are stated by Watt (7) to be powerfully emetic and cathartic although the plant is used as fodder for sheep and goats.

78. **Polygonum hydropiper** Linn. (Polygonaceae).

English names.—Biting Persicaria, Smartweed.

Indian name.—Be. *Packurmul.*

Distribution.—A rather robust annual herb found in damp places more or less throughout India up to 7,000 ft. in the Himalayas.

Remarks.—Seeds possess rubefacient and vesicant properties.

79. **Pongamia pinnata** (Linn.) Merr. syn. *P. glabra.* (Linn.) Vent. (Leguminosae).

English name.—Indian Beech.

Indian names.—Be. *Karanja*; Bo. & Hi. *Karanj.*

Distribution.—A moderate-sized almost evergreen tree met with all over India, on the bank of rivers and streams, especially near the seacoast and some forest localities; often planted as a roadside tree. It sometimes flowers as a shrub on the seacoast.

Constituents of the seeds.—The seeds contain 27 to 36.4 per cent of a bitter fatty oil and traces of an essential oil (25). Mature seeds contain 0.1 per cent glabrine, properties similar to α-aminoacids of the dicarboxylic acid type (102).

Remarks.—The seeds are said to be poisonous to fishes. 'A 2 per cent *P. glabra* oil-resin spray has been stated to be highly toxic against the nymph and adult stages of the green bug (*Coccus viridis*) on coffee, (103).

80. Prunus amygdalus Batsch, syn. *P. amygdalus* Baill.; *P. communis* (Linn.) Arcang. (Rosaceae).

English name.—Almond Tree.

Indin names.—Be. *Bilatibadam*; Hi. & Mar. *Badam*; Sans. *Badama*; Tam. *Vadumai*; Tel. *Badamu.*

Distribution.—A small to medium-sized tree cultivated in the cooler parts of the Punjab and Kashmir. Two varieties are recognized, viz., var. *amara* and var. *dulcis,* the bitter and sweet almonds.

Constituents of the seeds.—Almonds yield two distinct oils, a fixed oil and an essential oil. The sweet almonds do not yield any essential oil but the yield of the fixed oil varies from 35.5 to 62.5 per cent. The chief constituents of the essential oil are benzaldehyde, hydrocyanic acid and benzaldehydecyanhydrin (mandelonitrile). The essential oil is formed by hydrolysis of the glucoside amygdalin by means of the enzyme emulsion which is found in the seeds. On macerating the seeds in water, the enzyme is brought into contact with the dissolved glucoside, hydrolysing it into glucose, benzaldehyde and hydrocyanic acid. It is probable that a small quantity of amygdalin does occur in the sweet variety also (104).

Remarks.—The crude oil of bitter almonds which may contain up to 14 per cent of hydrocyanic acid is naturally very poisonous. The pure oil (benzaldehyde), on the other hand, has nothing in common with hydrocyanic acid as regards its action and is said in very large doses only to produce spasms which resemble epileptic fits.

81. Prunus armeniaca Linn. (Rosaceae).

English name.—Apricot.

Indian names.—Hi. & Pun. *Zardalu*; Kash. *Gurdalu*; Kum. *Zardaru.*

Distribution.—A medium-sized deciduous tree commonly cultivated in the north-west of India especially in the hills at altitudes of 6,000 ft. to 9,000 ft. above the sea level.

Constituents of the seeds.—Amygdalin has been found in the seeds probably in the bitter variety (11).

Remarks.—As in the case of almonds there is also a bitter variety of the seeds which is undoubtedly poisonous.

82. Prunus avium Linn. (Rosaceae).

English names.—Sweet Cherry, Wild Cherry-Tree.

Indian names.—Kum. *Gilas, Krusbal.*

Distribution.—A medium-sized tree cultivated in the North-Western Himalayas up to an altitude of 8,000 ft. especially in Kashmir.

Constituents of the seeds.—The seed kernels contains amygdalin (11).

83. **Prunus cerasoides** D. Don syn. *P. puddum* Roxb. *ex.* Wall. (Rosaceae).

English name.—Himalayan Cherry.

Indian names.—Bo. *Padmakasta*; Hi., Pun. & Kum. *Paddam*; Lep. *Kongki*; Sans. *Padmaksha.*

Distribution.—A moderate-sized to large tree found wild in the temperate Himalayas from Garhwal at altitudes of 3,000 to 6,000 ft. to Sikkim and Bhuttan from 5,000 to 8,000 ft. Also met with on the hill stations of Kodaikanal and Ootacamund in South India.

Constituents of the seeds.—The kernels are said to contain a substance which yields hydrocyanic acid (105).

84. **Prunus cerasus** Linn. (Rosaceae).

English names.—Dwarf Cherry, Sour Cherry.

Indian names.—Pers. & Urdu *Alubalu*; Pun. *Gilas.*

Distribution.—A deciduous shrub or a small tree producing many root-suckers. Cultivated in the Himalayas of the Punjab up to an altitude of 8,000 ft. for the sake of its fruits.

Constituents of the seeds.—The seed kernels have been found to contain the cyanogenetic glucoside amygdalin (106, 107).

85. **Prunus mahalab** Linn. (Rosaceae).

English names.—Mahaleb Cherry, St. Lucie Cherry.

Indian names.—Bo. *Gahula*; Pers. *Paiwandimiryam*; Sans. *Priyunger*; Urdu *Khewati.*

Distribution.—A small much branched shrubby tree cultivated in Baluchistan. Probably occurs in the north-west of India.

Constituents of the seeds.—The seeds are stated to contain amygdalin (108), and when chewed give a strong odour of hydrocyanic acid (10).

86. **Prunus padus** Linn. (Rosaceae).

English name.—European Bird Cherry.

Distribution.—A small to medium-sized deciduous tree, native of the temperate Himalayas from Kurrum at altitudes of 4,000 ft. to Sikkim and Bhutan between 8,000 to 12,000 ft.

Constituents of the seeds.—Seeds seem to contain the cyanogenetic glucoside amygdalin (11).

87. **Prunus persica** Batsch (Rosaceae).

English name.—Peach.

Indian names.—Garhwal *Khirola*; Hi., Pun. & Nep. *Aru*; Lep. *Takpo.*

Distribution.—A large deciduous shrub or a small tree widely cultivated in India especially in the north-west where it also occurs in a naturalized state up to an altitude of 10,000 ft. Cultivated extensively in the plains of the Punjab and North-West India and also in the Nilgiris between 5,000 to 7,000 ft. above sea level.

Constituents of the seeds.—The seed kernels contain amygdalin (107) and yield about 0.7 per cent of an essential oil, which consists chiefly of hydrocyanic acid, benzaldehyde and benzaldehydecyanhydrin (109).

88. **Pygeum gardneri** Hook. f. (Rosaceae).

Indian name.—Bo. *Daka.*

Distribution.—A medium-sized tree found in the Nilgiris and Bombay Ghats and common on the Mahableshwar Plateau.

Constituents of the seeds.—Seeds smell strongly of hydrocyanic acid.

89. **Ricinus communis** Linn. (Euphorbiaceae).

English names.—Castor-oil Plant, Castor-Bean.

Indian names.—Be. *Bherenda*; Bo. *Erendi*; Hi. *Arand*; Pun. *Arind*; Sans. *Eranda*; Tam. *Erandam*; Tel. *Erandamu.*

Distribution.—A tall stout annual, or perennial and sub-arboraceous. Originally probably from America, it is now extensively cultivated for its oil-bearing seeds and has also become naturalized near habitations in many parts of India.

Constituents of the seeds.—Seeds contain a fixed oil and a toxalbumin, ricin, which does not pass into the oil (90). The latter is a true protein and belongs to the same class of poison as abrin from *Abrus precatorius* Linn.

Remarks.—The entire seed is a very active poison. Three grains of the seeds have caused alarming symptoms and a case is reported where three seeds proved fatal to an adult in forty-six hours. Fatal cases of poisoning by castor-oil seeds administered in food have also been reported (14). Usually, however, five to six seeds are fatal to a child and twenty to an adult.

The oil is said to be an active poison for flies (90). Pammel (24) records the plant as a fish poison.

90. **Sapium indicum** Willd. (Euphorbiaceae).

Indian names.—Be. *Huru*; Bo. *Hurna*; Mal. *Venkshiri.*

Distribution.—An evergreen tree found in the Sunderbans, and in the West Coast along backwaters in Malabar and Travancore.

Remarks.—The seeds are employed as a fish intoxicant by local people where the tree grows.

91. **Schleichera oleosa** (Lour.) Merr., syn. *S. trijuga* Willd. (Sapindaceae).

English names.—Ceylon Oak, Honey Tree.

Indian names.—Bo. *Kosamb*; Hi. *Kosum*; Pun. *Kussumb*; Sans. *Koshamra*; Tam. *Pulichai*; Tel. *Pullakaya.*

Distribution.—A large tree found in dry forests of the Sub-Himalayan tract, from the Sutlej eastwards and throughout Central and Southern India.

Constituents of the seeds.—Seeds contain a fixed oil and small quantities of a cyanogenetic compound (110, 111).

Remarks.—Seeds and their oil have been the subject of much study. The oil is said to be occasionally mixed, as an adulterant, with mustard oil and 'ghee' and has thus caused symptoms of irritant poisoning. The seeds also have the same effects, producing giddiness, dilation of the pupils, and in fatal cases death from syncope presumably due to hydrocyanic acid.

92. Sesamum indicum Linn. syn. *S. orientale* Linn. (Pedaliaceae).

English names.—Gingelly, Sesame.

Indian names.—Be., Bo., Hi. & Pun. *Til*; Sans. *Tila*; Tam. & Tel. *Nuvvulu.*

Distribution.—An erect pubescent annual largely cultivated throughout India, being grown as an autumn or even as a winter crop in the warmer parts of the country (the truly tropical areas), and as a summer one in the colder areas.

Constituents of the seeds.—The seeds yield an oil which contains about 1 per cent of sesamin and sesmolin. The latter breaks up into a phenolic substance, sesmol and another substance samin (112).

Remarks.—Taken in large doses the oil acts as a purgative. The seed cake is commonly used in India for feeding cattle. It is not known whether any untoward symptoms have been produced, but Kobert (113), reports it to be toxic to livestock, causing colic, tremors, dyspnoea and distention. Kobert also states that the seeds have been used since olden times as emmenagogue and abortive, an opinion which has also been expressed by some writers in India. This view, however, seems to be incorrect, judging from the extent to which it is often eaten by Indian women, as for example during the 'bhugga' festival of the Hindus in the Punjab. The existence of any such belief among Indian ladies is unknown.

93. Solanum dulcamara Linn. (Solanaceae).

English names.—Poison Berry, Snake's poison-food.

Indian names.—Pers. *Anabessalib*; Pun. *Rubabarik.*

Distribution.—A sub-erect shrub found in the temperate Western Himalayas at altitudes of 4,000 to 8,000 ft. as a moist forest undergrowth. Common in Hazara, fairly common in Bushahr and frequently met with in many places between Kashmir and Garhwal. Also reported from Baluchistan and as far east as Sikkim.

Constituents of the seeds.—The plant contains the alkaloids solanine and solanidine, and the bitter glucoside dulcamarin (114). The berries inclusive of seeds are stated to contain 0.5 per cent of solanine (115).

Remarks.—The berries including the seeds are reputed to be an acro-narcotic poison in excessive doses and are stated to have been used to poison dogs and rabbits in foreign countries. Waddell (14) mentions a case in which a child aged 4 years is said to have died from eating two berries.

94. **Sophora mollis** R. Grah. (Leguminosae).

English name.—Himalayan Laburnum.

Indian names.—Garhwal *Sakina*; Pun. *Kohen*; Urdu *Arghavan.*

Distribution.—A low shrub found in the Himalayas and Sub-Himalayan tracts of North-Western India from Gilgit, Chitral, Hazara and the Salt Range to Kumaon and Nepal up to 7,000 ft. Locally common near Malakand, in Kagan and Kilba, Bushahr and Sahansradhara near Dehra Dun.

Constituents of the seeds.—It is likely that the seeds of this plant contain similar or identical alkaloid as found in the next species *S. tomentosa* Linn.

Remarks.—The seeds are stated to be useful for destroying vermin (17).

95. **Sophora tomentosa** Linn. (Leguminosae).

Indian names.—Sinhalese *Mudumuruga*; Burma *Thinbawmagyi.*

Distribution.—A small tree or a robust shrub found in the Andaman and Nicobar Islands and occasionally cultivated in Indian gardens.

Constituents of the seeds.—The seeds contain about 2.06 per cent of the poisonous alkaloid sophorine (116) which is identical with cytisine, the active constituent of Persian and Australian insect powders (14).

Remarks.—The use of this plant for insecticidal purposes has not been noted in literature, but it is very likely that proper investigation may yield positive results.

96. **Sorbus aucuparia** Linn. syn. *Pyrus aucuparia* Gaertn (Rosaceae).

English names.—European Mountain-Ash, Rowan.

Indian name: Pun. *Battal.*

Distribution.—A small tree common in the western temperate Himalayas from Kashmir to Kumaon at altitudes from 11,500 to 13,000 ft. above sea level.

Constituents of the seeds.—The de-fatted seeds were found to contain about 0.073 per cent of hydrocyanic acid (117).

97. **Stellaria media** (Linn.) Cyrill. (Caryophyllaceae).

English name.—Chickweed.

Distribution.—A very common weed found throughout the Punjab and temperate regions of India up to an altitude of 14,500 ft. in Tibet.

Remarks.—Pammel (24) states that the seeds of this plant are used as a food for birds, but quotes that they cause disorder of the digestive system when eaten in large quantities by lambs.

98. **Strychnos colubrina** Linn. (Loganiaceae).

Indian names.—Be. & Hi. *Kuchilalata*; Mal. *Modirakaniram*; Mar. *Kajarvel*; Tel. *Tigemushti.*

Distribution.—A large climbing shrub with bifid thickened tendrils found in western and southern parts of India in Bombay, Konkan, Poona, Kanra, Carnatic, Velligonda Hills of Nellore, Western Coast from south Kanara to Travancore to the lower forests of the Western Ghats.

Constituents of the seeds.—Roots, seeds and bark and wood contain the alkaloids brucine and strychnine (11).

Remarks.—As strychnine is present in considerable quantities the seeds which are used medicinally should be employed with great caution. Strychnine is a violent tetanic poison. The seeds are also likely to be poisonous to fishes.

99. **Strychnos nux-vomica** Linn. (Loganiaceae).

English names.—Nux-vomica Tree, Strychnine Tree.

Indian names.—Be. *Kuchila*; Bo. *Kajra*; Hi. *Kuchla*; Sans. *Kachchira*; Tam. *Mutti*; Tel. *Mushti.*

Distribution.—A deciduous tree found in the forests of Gorakhpur, Bihar and Orissa, Konkan, North Kanara, Southern Mahratta Country, Northern Circars, the Deccan and Carnatic; also on the West Coast of the Madras State in deciduous forests and up to 4,000 ft. in hilly country.

Constituents of the seeds.—Strychnine is the most important alkaloid contained in this plant; besides this there are present brucine and a few other alkaloids. These compounds exist not only in the seeds, the most important part of the plant, but also in the root, wood, bark, leaves, fruit pulp, etc.

The seeds also contain the glucoside loganin (11).

Remarks.—The seeds are highly poisonous. A case is reported by Taylor in which thirty grains of the powdered seeds (equal to about one full-sized seed), taken in two doses of fifteen grains each, caused death of a girl aged ten; and in two other cases death was produced from fifty grain doses (14). Watt (7) mentions that the seeds are employed by country distillers, who sometimes add a small quantity of them to 'arrak' so as to render it more intoxicating. He also states that the seeds are used by the hill tribes of Nilgiris as a fish poison. Mixed with starch or flour or soot it is largely used for killing vermin who damage the cultivated fields and for destroying stray dogs. Numerous cases of accidental poisoning of man and animals are on record. Occasionally suicidal cases are reported in India but homicidal cases are comparatively rare.

100. **Taxus baccata** Linn. (Taxaceae).

English name.—Yew.

Indian names.—Be. *Bhirmie*; Bo. *Barmi*; Hi. & Pun. *Birmi.*

Distribution.—A small or medium-sized evergreen tree met with in the temperate Himalayas at altitudes of 6,000 to 11,000 ft., and in the Khasia hills at altitudes of 5,000 ft.

Constituents of the seeds.—A toxic alkaloid, taxine (100) which acts as a narcotic, producing cardiac depression and death through respiratory failure.

Remarks.—The seeds are poisonous and not the fleshy cup surrounding them and several cases of death among human beings and animals have been reported on account of eating the seeds. The succulent cup is eaten in certain parts of the Himalayas the seeds only being rejected.

101. **Tephrosia candida** (Roxb.) DC. (Leguminosae).

Indian name.—Hi. *Lashtia.*

Distribution.—A weak shrub found in the tropical Himalayas from Garhwal to Khasia and Assam ascending up to an altitude of 5,000 ft. in Sikkim; also in Chittagong and the Sameshwar hills. It is occasionally grown as an ornamental plant.

Constituents of the seeds.—Seeds contain 0.5 per cent rotenone (126).

Remarks.—The plant has been recorded by Gamble (118) as a fish poison in Eastern Bengal and Burma. An extract (119) of the seeds has been tested for its insecticidal properties in small-scale field trials, and found to be quite efficacious though the bark and the leaves are chiefly used for this purpose.

102. **Thevetia peruviana** Schum. syn. *T. neriifolia* Juss. (Apocynaceae).

English names.—Yellow Oleander, Bastard Oleander.

Indian names.—Be. *Kokilphul*; Bo. & Hi. *Pilakanir*; Sans. *Karavira*; Tam. *Pachaiyalari*; Tel. *Pachchaganeru.*

Distribution.—A large evergreen shrub or a small tree, originally a native of America and West Indies, but now almost naturalized in some places. There is scarcely a garden in the plains without a few shrubs, if not a hedge.

Constituents of the seeds.—Seeds contain the toxic glucosides thevetin, thevetoxin, ahouain, etc.; thevetin is a strong heart poison. The seeds contain glucosides neriifolin, acetylneriifolin, thevetin (120).

Remarks.—Seeds have long been known to be highly poisonous and have been commonly used for suicidal, homicidal and abortifacient purposes. Of late years they have come into extensive use in some parts of the Bombay State as a cattle poison. The Mundas use the seeds to poison pigs and jackals. They are also said to be used in the preparation of ipos or Malay arrow poisons. In Brazil the plant has been employed as a fish poison (14, 24).

The oil extracted from the seeds is said to be emetic and purgative. According to Shortt, it produces violent vomiting and hypercatharsis (10).

103. **Tinospora cordifolia** (DC.) Miers (Menispermaceae).

Indian names.—Be., Hi. & Pun. *Giloe*; Bo. *Guloe*; Sans. *Guluchi*; Tam. *Amudam*; Tel. *Guduchi.*

Distribution.—A large glabrous climber found throughout tropical India, Burma, Andamans and Ceylon.

Remarks.—The author has been told that some seeds obtained from a *post-mortem* examination of a case of suspected poisoning were sent to the Director, Botanical Survey of India. They were identified as belonging to this species. It is possible that the seeds are poisonous, though no work has so far been done to confirm this view.

104. Verbascum thapsus Linn. (Scrophulariaceae).

English names.—Common Mullein, Mullein Dock.

Indian names.—Hi. *Gidartamaku*; Pun. *Bantamaku*; Urdu *Janglitamak.*

Distribution.—A stout herb found in the temperate Himalayas between 5,000 to 12,000 ft. above sea level and in Western Tibet. It also occurs in the Western Ghats and in the Nilgiris in the neighbourhood of Ootacamund where it has been introduced and is now rapidly spreading (122).

Constituents of the seeds.—The seeds contain 0.37 per cent of a saponin (121).

Remarks.—According to O'Shaughnessy (7) the seeds are supposed to be narcotic and are used for poisoning fish. The present author has not, however, come across the use of the seeds as a fish poison.

105. Vicia sativa Linn. var. **angustifolia** Baker (Leguminosae).

English name.—Narrow-leaved Vetch.

Distribution.—A diffuse annual abundant as a weed in cultivated ground throughout Northern India.

Constituents of the seeds.—Seeds contain a cyanogenetic glucoside vicianin and also the gluco-alkaloid vicine. Vicine is present in the largest amount in the immature seeds.

Remarks.—Of late years the seeds have been implicated in the causation of a disease called lathyrism although there is still insufficient evidence to connect lathyrism in man with the ingestion of these seeds. The seeds when fed to ducks cause death.

106. Withania somnifera Dun. (Solanaceae).

Indian names.—Be. & Bo. *Asvagandha*; Hi. & Pun. *Asganda*; Sans. *Ashvagandha*; Tam. *Asuvagandi*; Tel. *Asvagandhi.*

Distribution.—An erect weedy-looking shrub or undershrub found throughout the drier parts of India, especially in waste places, ascending to 5,000 ft. on the Himalayas.

Remarks.—A fatal case of poisoning due to the seeds has been recorded (10).

ACKNOWLEDGEMENTS

The author is very grateful to Dr. B. Mukerji, Director, Central Drug Research Institute, Lucknow, for the very valuable help and guidance that he has given.

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THE GENUS *CYATHULA* LOUR. IN INDIA

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The genus *Cyathula* Lour. belongs to the tribe Amaranteae of the family Amarantaceae and comprises ten species distributed over tropical Asia, Africa, and South America (Willis, 1951). Of these, *C. tomentosa* Moq., *C. capitata* Moq., *C. ceylonica* Hook. f. and *C. prostrata* Blume are reported from India (Hooker, 1885). Hooker has divided these four species into two groups: one with the clusters of flowers arranged 'in large globose heads' and the other with 'small, solitary, spicate, reflexed' flower clusters. The first group includes *C. tomentosa*, *C. capitata* and *C. ceylonica*, and the second *C. prostrata*. The differentiating characters of the two groups are fairly good; in other words, *C. prostrata* has been founded on characters which clearly mark it out from the three species of the other group. The present paper deals with this latter group of species.

Hooker (1885) and almost all the other taxonomists differentiate *C. tomentosa* from *C. capitata* on the basis of the 'densely hairy or woolly' appearance of the former, and the 'sparsely hairy' organs of the latter. However, on my numerous visits to the Simla Hills during 1951–53, I found that these so-called differentiating characters of the two species are not stable. On the lower altitudes (3–5,000 ft.) the plants are mostly densely hairy and are usually identified as *C. tomentosa*. As we go higher the tomentose character decreases considerably, and at a height of about 7–8,000 ft. they are almost glabrescent and are identified as *C. capitata*: an observation very nearly coinciding with the respective altitude records for the two species (Hooker, 1885). This appeared to be interesting and I devoted myself almost exclusively to the hills in Simla proper and a few adjacent areas. A very large number of specimens were collected from different localities which included the low-lying Glenn, Annandale, Sanjouli, etc., the highest points at Taradevi, Jatog, Summer Hill, Jakhu, and others, as also all the possible intermediate heights. The range of altitude covered was from about 4,000 to 7,500 ft. Detailed ecological and morphological notes for each collection were made. The results were quite interesting.

It was seen that the specimens of lower altitudes are densely hairy but as we proceed higher up, the plants *gradually* begin losing the woolly character. So gradual and regular is the alteration in their appearance that at certain stages it becomes really difficult to identify the two 'species' merely on the basis of their hairy character! As one nears the collections from the top of the mountains, the hairs become less pronounced. They are more widely spaced and are considerably shorter. It is as if the closely growing epidermal appendages of the 'lower' plants become scattered and shorter as the plants 'ascend' along the mountains giving rise to the less hairy type at the top. The 'lower' specimens are obviously those of *C. tomentosa* and the 'upper' of *C. capitata*. The two, therefore, appear to be ecotypes of each other. It seems that Hooker (1885) also was probably doubtful about the stability of the woolly character of *C. tomentosa* as he has remarked that the species is 'variable in the density of tomentum'. An almost similar case was recorded by me earlier (Bakshi, 1952) for *Anisochilus eriocephalus* Benth. in which the hairy or glabrous nature of the calyx is controlled by the nature of the substratum. The sepals are woolly when the plant is grown on loam, but they gradually become glabrous as the soil is made deficient in organic matter. This led me to conclude that 'the distances between the epidermal appendages of the calyx, the differences in their lengths, and even their complete absence are not characters sufficient to warrant the separation of the two plants into two distinct species (*A. eriocephalus* and *A. carnosus*). One can easily obtain the desired form by growing the plants on appropriate soil.'

If, therefore, *Cyathula tomentosa* is not different from *C. capitata*, the number of species in the first group of the Indian records of the genus is reduced to two, viz., *C. tomentosa* (Syn. *C. capitata*) and *C. ceylonica*. The differentiating characters of these can be enumerated as follows :

Cyathula tomentosa Moq. (Syn. *C. capitata* Moq.)	*Cyathula ceylonica* Hook. f.
1. A straggling undershrub, densely woolly or sparsely hairy; stems stiff, obtusely four-angled.	1. An erect tomentose plant with slender terete branches.
2. Leaves 2–10 inches long, elliptic, acute, acuminate, base acute, petiole ¼–1 inch long.	2. Leaves 1½–2 inches long, subsessile, elliptic, subacute.
3. Heads 1–1½ inches in diameter, white, glistening, close or distant on a 2–6 inches long-peduncled spike.	3. Heads 1 inch in diameter, globose, solitary.

SUMMARY

The genus *Cyathula* Lour. comprises ten species of which *C. tomentosa* Moq., *C. capitata* Moq., *C. ceylonica* Hook. f. and *C. prostrata* Blume are recorded from India. Of these the first three have clusters of flowers 'in large globose heads', and the last has 'small, solitary, spicate, reflexed' flower clusters. The present paper deals with the first group of species.

The earlier authors differentiate *C. tomentosa* from *C. capitata* on the basis of the 'densely hairy or woolly' appearance of the former and the 'sparsely hairy' organs of the latter. However, these so-called differentiating characters have been found to be variable. It was seen that the density of tomentum is inversely related to the altitude at which the plants grow; the lower the altitude, the more the tomentum. It has,

therefore, been concluded that the two species are not different from one another in morphological characters.

The differentiating characters of *C. tomentosa* (Syn. *C. capitata*) and *C. ceylonica* have been enumerated in a tabular form.

ACKNOWLEDGEMENTS

I am grateful to Rev. Father Santapau, S.J. (St. Xavier's College, Bombay) for kindly going through the manuscript, and to Mr. R. N. Kapil (University of Delhi) for help with the literature.

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THE ECOLOGY AND BEHAVIOUR OF THE SCORPION *PALAMNAEUS BENGALENSIS* C. KOCH

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(*With two text figures*)

Fabre, Ainsworth, Lydekker, Vanchon and others have written on the habitats and behaviour of scorpions in general, but accounts of any species of scorpions in their natural homes, their way of life therein and in captivity are lacking. It was, therefore, felt desirable to study these aspects of the common large, black Indian scorpion, *Palamnaeus bengalensis* C. Koch.

Palamnaeus bengalensis lives in dry, unused and uncultivated ridges of land (' bunds ') which abound in small shrubs and bushes that make a dry, dark and shady atmosphere (Lal and Kanungo). On both the sloping sides of these ridges one has to look for narrow, almost crescentic openings, 2·0″ – 3·5″ long and 0·5″ – 1·5″ high, scattered here and there (Fig. 1). These openings are characteristic of these scorpions and lead to the chambers which they dig into the ridges themselves. Sometimes numerous smaller openings of a similar nature, about 0·7″ – 1·2″ long and 0·3″ – 0·6″ high may also be found, but these lead through very short passages to the living quarters of another variety of very small, black scorpion of a different genus. The length or width of the

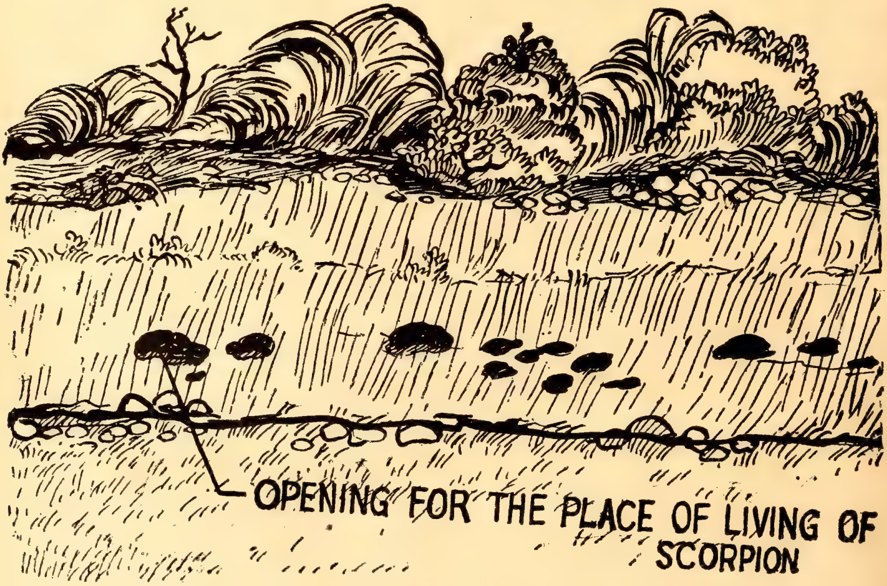
OPENING FOR THE PLACE OF LIVING OF SCORPION

Fig 1.

opening of the home of *P. bengalensis* is approximately equal to the distance between its pedipalpi in normal posture. The crescentic appearance of the opening is usually lost during the rains, but the opening is always maintained in some form or other as the scorpion gets its oxygen supply through this only. When the earth dries up, the opening regains its form gradually as the scorpion moves in and out. Each opening leads through a long, sinuous passage, which is almost circular in cross-section, to the place of living of a single scorpion family (Fig. 2). On many occasions big, white scorpions of the genus *Buthus* were also found inhabiting similar chambers, which, as far as the author has been able to ascertain, are not the invaded homes of *P. bengalensis*, but are dug by *Buthus* themselves. On a dry summer day one has to dig a foot or more before encountering the scorpions. Though mostly only a single adult, male or female, is found, one may very rarely also find a pair together. The young are seen playing about or may also be seen carried on the back of the mother, concealing her outline. On rainy days if water enters their dwelling places they come out. But the openings are always situated at a higher level to avoid such mishap.

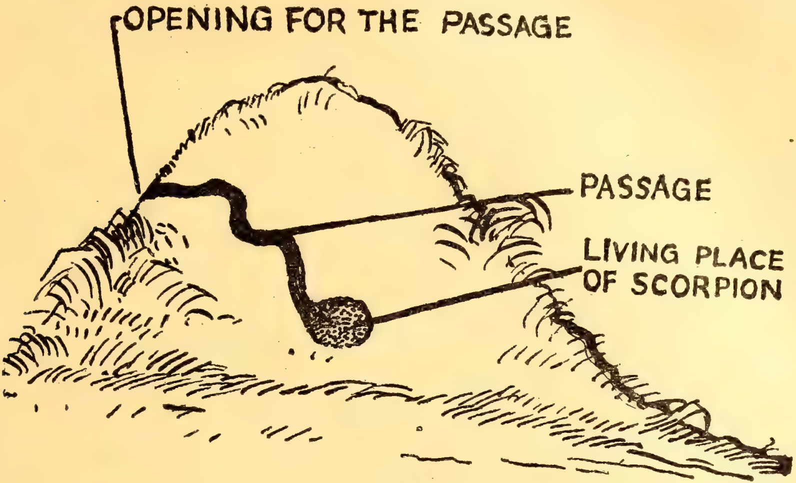

Fig. 2

The passage to the dwelling place of scorpions often shows accumulations of chitinous skeletons of insects, myriapods, spiders, and egg-shells of lizards and other animals on which the animal feeds. It goes in quest of food at night, but not each night. After procuring a good meal, it goes back to its living place where it stays for nights together without moving out. It resembles other arachnids in this habit. Dried leaves and sticks were kept at the openings taking care that sufficient air got into the chambers, lest the animals came out due to suffocation. In some cases the leaves and sticks were found to be displaced the very next day and in some they were not displaced even after three or four days. Live scorpions were found when such homes were dug out. When the openings were completely blocked and the nest dug out the next day all the scorpions were found alive. But when closed for more days some were found alive and some dead. This shows that they can survive for a long period without any supply of oxygen.

Scorpions are said to live among stones, bricks and dried leaves. But in all probability, all varieties of scorpions do live in homes which they dig in dry shady places as has been mentioned here for *P. bengalensis* and other types. When they are unfortunately forced to abandon this natural habitat, it is only a dry place with bricks, stones and dried leaves that provides them with the next best living place. Here they survive well and breed, but it is difficult for them to dig shelters with passages.

The longevity of *P. bengalensis* in captivity varies with the surroundings in which it is kept. Scorpions captured from their nest-holes were kept in clean glass vessels and the longest time they survived was about a fortnight. When the same glass vessels were filled with dried leaves, bits of wooden sticks and soil they lived for about a month. Wooden boxes and earthen vessels with bricks, stones and dried leaves proved better as they lived for more than a month in these. In winter they died earlier in captivity than in summer or in the rains. It has also been observed that females live longer than males, and pregnant females the longest.

It is very interesting to observe the behaviour of scorpions in captivity. They are active at night. Though their ferocious activity remains the same in captivity as in their natural home, many remain together in captivity without quarrelling. They were never seen to mate. They sting any animal that molests them. If living insects are supplied to them they try to grasp the prey, but if alarmed will stop, curl the tail and escape. Or, they attack them boldly with their stings and pincers. When killed they are made into pieces and either eaten or left. Scorpions eat their own kind as well. In captivity a white *Buthus* was seen feeding upon a *P. bengalensis* which was dying due to starvation. First it began biting it between the tergum and sternum to expose a greater area, and simultaneously sucked pulp from the body of the prey for about two hours and then left it unfinished. Like other arachnids they can survive prolonged fasts. The food of a scorpion seems to provide it with sufficient moisture, for it has been observed that it lives for three to four weeks in captivity without water. Water derived from food is used for the metabolic activity in the body. Water loss of the body is avoided due to a thick impermeable cuticle, and the faeces are also discharged in solid form after the water has been absorbed by the rectal walls. However, water supplied is very gladly taken. Scorpions were kept many times in dishes with some water and they were seen to suck the water with the movement of chelicerae and one could hear the sound produced during sucking.

It is easy to instigate a quarrel between a male and a female scorpion by constantly bringing them into head-on collision. They catch hold of each other by the pincers, try to grasp the head and strike with the sting at any part of the foe. Once a male and a female were made to quarrel, the female often caught the male uncomfortably, and both started striking each other with their stings. But neither seemed to be affected by the other's poison. In order to study the behaviour between scorpions of different genera, a specimen of *Buthus* was kept with a *P. bengalensis*. They did not appear to live well together and started fighting. They caught hold of each other by the pincers. The more active *Buthus* stung its foe at the third joint of the tail. Soon the latter stopped fighting and stayed quietly. Its condition grew worse, but after two hours it recovered. The effect of poison seemed to stay till the next morning, as it did not move about much even when disturbed. The scorpions in captivity were never seen to be affected by their own poison. They, therefore, cannot commit suicide.

Some of the scorpions in captivity showed ecdysis. The cuticle was cast off in bits with the help of the limbs. They did not show any signs of regeneration. Limbs and stings of both adult and very young ones were cut but there were no signs of new growths at the cut ends even after fifteen days.

I am extremely thankful to Dr. M. B. Lal, Department of Zoology, University of Lucknow, for his kind guidance in the work. My thanks are also due to the U. P. Government Scientific Research Committee for a grant to conduct this work.

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CHECKLIST OF THE TRIDACTYLIDÆ AND GRYLLIDÆ (INSECTA, ORTHOPTERA) OF CEYLON, WITH RECORDS OF DISTRIBUTION

BY

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Introduction

The following report is based on the named material of two orthopterous families, the Tridactylidæ and Gryllidæ in the collection of the Colombo Museum. In May 1925, Dr. L. Chopard of Paris published the first list of the ' Gryllidæ of Ceylon in the British Museum Collections,' comprising specimens mostly collected by the late Mr. E. E. Green, in the *Annals and Magazine of Natural History* (Series 9), Vol. xv, pp. 505-536. This important collection consisted of sixty-one species, of which thirteen were described as new to science. More specimens collected by Mr. G. M. Henry were later sent to him for study by the Colombo Museum, and from this collection some twelve more forms were added to the known list in 1928, thereby increasing the total number of species recorded from the Island to seventy-three. Since then rather important collections of Gryllidæ from the Colombo Museum have been despatched to Dr. Chopard, who finally published a most valuable paper on the ' Tridactylidæ and Grillidæ of Ceylon' in the *Ceylon Journal of Science* (*Section B*), Vol. xx, Part 1, pp. 9-87, in August 1936.

The collection of Crickets in the Colombo Museum has recently been worked out and completely re-arranged by me, and during the progress of this work it was considered worth while to draw up the present checklist giving records of the local distribution as fully as possible. The family Tridactylidæ alone comprises eight Ceylonese forms, all belonging to a single genus *Tridactylus*, and the Gryllidæ is represented by a much larger number totalling ninety-one species in all, distributed amongst forty-six genera. The fauna of the Gryllodea, including the Tridactylidæ, of Ceylon now consists of ninety-nine species altogether, and it must, I should think, very nearly include the total number of species of the group to be found in Ceylon. The collection of Gryllidæ and Tridactylidæ in the National Museum of Ceylon comprises a large series of beautifully preserved specimens collected from several localities some in remote parts of the Island and, moreover, it is worthy of special attention for it contains a considerable number of species which are peculiar to Ceylon. The endemic forms alone number a little more than half the total species recorded. And besides, this very valuable collection contains numerous type-specimens some of which are unique.

The references to original descriptions of the different species have been worked out as far as is practicable from the literature available in the Colombo Museum Library. The reference to synonyms is also cited with the type-locality of synonymized forms, where known, immediately after the original reference. The following catalogue is mainly intended to facilitate the study of the known Ceylonese species and at the same time to furnish a basis for future work. It is, furthermore, desired to place on record observations on local distribution.

Family 1. **Tridactylidae**

Genus TRIDACTYLUS Olivier

Ency. Meth. Ins. iv, p. 26 (1789); *Heteropus* Beauvois, Ins. Afr. Amer. p. 231 (1805); *Xya* Burmeister, Handb, Ent. ii, p. 741 (1838).

1. *Tridactylus variegatus* (Latreille)

Gen. Crust. Ins. iv, p. 383 (*Xya*) (1809); *Xya japonica* De Haan, Temn. Verh. Orth. p. 238 (1842); *Xya obscura* Motschulsky, Bull. Mosc. xxxix, p. 182 (1866); *Tridactylus riparius* Saussure, Mém. Soc. Geneve, xxv, p. 48 (1877); *Tridactylus flavimaculatus* Matsumura, Mém. Soc. Ent. Belg. p. 131 (1911); *Tridactylus japonicus* Chopard, Ann. Mag. Nat. Hist. (9) xv, p. 506 (1925); Chopard, Ceylon J. Sci. (B) xx, p. 13 (1936).

Dist. Ceylon: Colombo, Battaramulla, Kesbewa (Western Province), Peradeniya, Matale, Sigiriya (Central Province); Mihintale (North Central Province); Trincomalee, Tennamaravadi Yanoya (Eastern Province); Punduluoya (Uva Province); Asia; Africa: Australia and Europe.

Type-locality 'France meridionale'.

2. *Tridactylus nigroaenus* Walker

Cat. Derm. Salt. Brit. Mus. v. suppl. p. 1 (1871); Chopard, Ceylon J. Sci. (B) xx, p. 13 (1936).

Dist. Ceylon: Colombo (Western Province); Peradeniya, Haragama (Central Province); Polonnaruwa (North Central Province); Katagamuwa (Southern Province); India.

Type in the British Museum (Natural History). *Type-locality* 'Ceylon'.

3. *Tridactylus nigripennis* Chopard

Ceylon J. Sci. (B) xx, p. 14 (1936).

Dist. Ceylon: Kitulgala (Sabaragamuwa Province); Bibile Uva Province).

Type (female) in the Colombo Museum. *Type-locality* Bibile, July 1929 (G. M. Henry).

4. *Tridactylus curtus* Chopard

Ceylon J. Sci. (B) xx, p. 14, fig. 1 (1936).

Dist. Ceylon: Wellawaya, Bintenne (Uva Province).

Type (male) in the Colombo Museum. *Type-locality* Wellawaya, April 1931 (G. M. Henry).

5. *Tridactylus quadrimaculata* Chopard

Ceylon J. Sci. (B) xx, p. 15, fig. 2 (1936).

Dist. Ceylon: Bintenne (Uva Province).

Type (female) in the Colombo Museum. *Type-locality* Bintenne, October 1928 (G. M. Henry).

6. *Tridactylus opacus* Walker

Cat. Derm. Salt. Brit. Mus. v, suppl. p. 1 (1871); *Tridactylus nitobae* Shiraki, Mon. Gryll. Formose, p. 15, pl. 1, fig. 1 (1911); Chopard, Ann. Mag. Nat. Hist. (9) xv, p. 506. (1925).

Dist. Ceylon: Peradeniya. Nawalapitiya (Central Province); Southern Asia.

Type in the British Museum (Natural History). *Type-locality* 'Ceylon'. This species is not represented in the collection of the Colombo Museum.

7. *Tridactylus thoracius* De Guérin.

Mém. Icon. Anim. Ins. iii, p. 336 (1844); Chopard, Ann. Mag. Nat. Hist. (9) xv, p. 506 (1925).

Dist. Ceylon: Colombo (Western Province); Kandy, Peradeniya (Central Province); Timbolketiya (Sabaragamuwa Province); Katagamuwa (Southern Province); India; Malay Archipelago.

Type in the Leyden Museum. *Type-locality* 'Madagascar'.

8. *Tridactylus ceylonicus* Fernando

Ceylon J. Sci. (B) xxiv, p. 47, fig. 1 (1950).

Dist. Ceylon: Colombo (Western Province).

Type in the Ceylon University. *Type-locality* Colombo. (W. Fernando.)

Family 2. **Gryllidae**

Subfam. 1. **Gryllotalpinae**

Genus GRYLLOTALPA Latreille

Gen. Crust. Ins. iii, p. 275 (1802).

9. *Gryllotalpa africana* Beauvois

Ins. Afr. Amer. p. 229, pl. 2c, fig. 6 (1805); *Gryllotalpa orientalis* Burmeister, Handb. Ent. ii, p. 739 (1839); *Gryllotalpa ornata* Walker, Cat. Derm. Salt. Brit. Mus. i, p. 5 (1869); Chopard, Ceylon J. Sci. (B) xx, p. 19 (1936).

Dist. Ceylon: Colombo, Kotte (Western Province); Kandy, Mousakande Gammaduwa, Karagahatenne Gammaduwa, Nuwara Eliya, Hakgala (Central Province); Kalawewa (North Central Province); Balangoda, Kitulgala, Rakwana, Madola Opanake (Sabaragamuwa Province); Bandarawela (Uva Province); Murunkan, Marichchukaddi (Northern Province); Asia; Australia; Africa.

Type-locality 'Afrique'.

Subfam. 2. **Gryllinae**

Genus BRACHYTRYPES Serville

Hist. Nat. Ins. Orth. p. 323 (1839).

10. *Brachytrypes orientalis* (Burmeister)

Handb. Ent. ii, p. 735 (*Gryllus*) (1838); Chopard, Ceylon J. Sci. (B) xx, p. 20 (1936).

Dist. Ceylon: Balangoda (Sabaragamuwa Province); India.
Type-locality 'Tranquebar'. This species is represented by a solitary famale specimen in the Colombo Museum collection.

Genus GYMNOGRYLLUS Saussure

Mém. Soc. Geneve, xxv, p. 123 (1877).

11. *Gymnogryllus erythrocephalus* (Serville)

Hist. Nat. Ins. Orth. p. 339 (*Gryllus*) (1839); Chopard, Ann. Mag. Nat. Hist. (9) xv, p. 508 (1925).

Dist. Ceylon: Colombo, Battaramulla, Kotte (Western Province); Marai Villu (North Western Province); Peradeniya, Matale (Central Province); Bintenne (Uva Province); Marichchukaddi Northern Province): India; Malay Archipelago.

Type in the Paris Museum. *Type-locality* Bengal.

var. *melanocephalus* Chopard.

Ark. f. Zool. 23A, No. 9, p. 7 (1931): Chopard, Ceylon J. Sci. (B) xx, p. 21 (1936).

Dist. Ceylon: Marichchukaddi (Northern Province); India; Malay Archipelago.

Type in the Paris Museum. *Type-locality* Sumatra.

12. *Gymnogryllus humeralis* (Walker)

Cat. Derm. Salt. Brit. Mus. v, suppl. p. 5 (*Gryllus*) (1871); Chopard, Ann. Mag. Nat. Hist. (9) xv, p. 508 (1925).

Dist. Ceylon: Colombo, Dehiwela, Battaramulla, Hanwella (Western Province); Chilaw (North Western Province); Kandy, Peradeniya (Central Province); Balangoda, Madola Opanake, Rakwana (Sabaragamuwa Province); Badulla (Uva Province); Nirodumunai, Trincomalee (Eastern Province); India.

Type in the British Museum (Natural History). *Type-locality* Bombay.

Genus ITAROPSIS Chopard

Ann. Mag. Nat. Hist. (9) xv, p. 511 (1925).

13. *Itaropsis tenellus* (Walker)

Cat. Derm. Salt. Brit. Mus. 1, p. 37 (*Gryllus*) (1869); *Gryllus parviceps* Walker, Loc. cit. v, suppl. p. 8 (1871); *Itaropsis parviceps* Chopard, Ann. Mag. Nat. Hist. (9) xv, p. 510 (1925); *Anurogryllus tenellus* Chopard, loc. cit., p. 508, fig. 2 (1925); Chopard, Celyon J. Sci. (B) xx, p. 21 (1936).

Dist. Ceylon: Kotte, Battaramulla (Western Province); Kandy, Peradeniya, Matale, Mousakande Gammaduwa (Central Province); Kalawewa (North Central Province); Ratnapura, Balangoda (Sabaragamuwa Province); Uva Highlands, Bandarawela (Uva Province); India.

Type in the British Museum (Natural History). *Type-locality* 'Ceylon.'

Genus GRYLLUS Linnaeus

Syst. Nat. (ed. x), p. 425 (1758); *Liogryllus* Saussure, Mém. Soc. Geneve, xxv, p. 134 (1877).

14. *Gryllus bimaculatus* De Geer

Mém. Ins. iii, p. 521, pl. xxxxiii. fig. 4 (1773); *Acheta bimaculata* Chopard, Ann. Mag. Nat. Hist. (9) xv, p. 509 (1925); Chopard, Ceylon J. Sci. (B) xx, p. 22 (1936).

Dist. Ceylon: Colombo (Western Province); Kandy, Mousakande Gammaduwa (Central Province); Maha Illupalama (North Central Province); Murunkan, Illupukaduvai (Northern Province); Asia; Australia and Africa.

Genus GRYLLULUS Uvarov

Ann. Mag. Nat. Hist. (10) xvi, p. 320 (1935).

15. *Gryllulus testaceus* (Walker)

Cat. Derm. Salt. Brit. Mus. 1, p. 38 (*Gryllus*) (1869).

Dist. Ceylon: Colombo, Battaramulla, Kotte (Western Province): Puttalam (North Western Province); Kandy, Peradeniya (Central Province); Balangoda (Sabaragamuwa Province); Vavu-niya, Murunkan (Northern Province); Southern Asia.

Type in the British Museum (Natural History). *Type-locality* Canton.

16. *Gryllulus mitratus* (Burmeister)

Handb. Ent. ii, p. 734 (*Gryllus*) (1838); *Gryllus occipitalis* Serville Hist. Nat. Ins. Orth. p. 339 (1839).

Dist. Ceylon: Battaramulla. (Western Province); Marai Villu (North Western Province); Kandy, Peradeniya, Matale (Central Province); Diyatalawa (Uva Province); Warahamankada (Southern Province); Southern Asia.

Type in the Leyden Museum. *Type-locality* Java.

17. *Gryllulus configuratus* (Walker)

Cat. Derm. Salt. Brit. Mus. v, suppl. p. 8 (*Gryllus*) (1871); *Gryllus quadristrigatus* Chopard, Ann. Mag. Nat. Hist. (9) xv, p. 510 (1925); *Gryllus configuratus* Chopard, Ceylon J. Sci. (B) xiv, p. 198 (1928).

Dist. Ceylon: Colombo, Kotte, Battaramulla (Western Province); Sigiriya, Mousakande Gammaduwa, Woodside Urugala (Central Province); Diyatalawa, Wellawaya, Bintenne, Galge (Uva Province); Warahamankada (Southern Province); Murunkan, Marichchukaddi (Northern Province); India.

Type in the British Museum (Natural History). *Type-locality* Bombay.

18. *Gryllulus flavus* Chopard

Ceylon J. Sci. (B) xx, p. 24 (1936).

Dist. Ceylon: Battaramulla (Western Province); Balangoda, Madola Opanake, Rakwana (Sabaragamuwa Province).

Type (female) in the Colombo Museum. *Type-locality* Rakwana, May 1929 (G. M. Henry).

19. *Gryllulus confirmatus* (Walker)

Ann. Mag. Nat. Hist. (3) iv, p. 221 (*Acheata*) (1859); *Gryllus consobrinus* Saussure, Mém. Soc. Geneve, xxv, p. 188 (1877); *Gryllus confirmatus* Chopard, Ann. Mag. Nat. Hist. (9) xv, p. 509 (1925).

Dist. Ceylon: Colombo, Kotte, Battaramulla (Western Province); Kandy, Peradeniya, Matale (Central Province); Mihintale, Eppawala (North Central Province); Ratnapura (Sabaragamuwa Province); Wellawaya, Bintenne (Uva Province); Trincomalee (Eastern Province); Vilapalawewa, Barberyn (Southern Province); Elephant Pass, Murunkan (Northern Province); Southern Asia.

Type in the British Museum (Natural History). *Type-locality* 'Ceylon'.

20. *Gryllulus bucharicus* (Bei-Bienko)

Bol. Soc. Esp. Nat, Hist. xxxiii, p. 323, fig. 8 (*Gryllus*) (1933) Chopard, Ceylon J. Sci. (B) xx, p. 25 (1936).

Dist. Ceylon: Marai Villu (North Western Province); Bandarawela (Uva Province); Marichchukadde (Northern Province); India.

Type in the Leningrad Museum. *Type-locality* 'Turkmenistan'.

21. *Gryllulus brevicauda* Chopard

Ceylon J. Sci. (B) xx, p. 26, fig. 3 (1936).

Dist. Ceylon: Colombo, Battaramulla (Western Province); Kandy (Central Province); Balangoda (Sabaragamuwa Province); Wellawaya, Bintenne (Uva Province).

Type (female) in the Colombo Museum. *Type-locality* Bintenne, October 1928 (G. M. Henry).

22. *Gryllulus blennus* (Saussure)

Mém. Soc. Geneve, xxv, p. 215 (*Gryllodes*) (1877); *Gryllus flavipes* Chopard, Ceylon J. Sci. (B) xiv, p. 197, figs. 1-2 (1928). *Type-locality* Colombo, Ceylon, February 1924 (male); Chopard, Ceylon J. Sci. (B) xx, p. 27 (1936).

Dist. Ceylon: Colombo, Battaramulla (Western Province); Marai Villu (North Western Province); Madola Opanake (Sabaragamuwa Province); Bandarawela (Uva Province); Mahaoya (Eastern Province); India; Malay Archipelago.

Type in the Leyden Museum. *Type-locality* 'Java'.

23. *Gryllulus pallipes* (Chopard)

Ann. Mag. Nat. Hist. (9) xv, p. 510, fig. 3 (*Gryllus*) (1925).

Dist. Ceylon: Colombo, Battaramulla (Western Province); Peradeniya (Central Province); Rakwana (Sabaragamuva Province).

Type (female) in the British Museum (Natural History). *Type-locality* Peradeniya, March 1907 (E. E. Green).

Genus GRYLLODES Saussure

Miss. Méx. Orth. p. 409 (1874).

24. *Gryllodes sigillatus* (Walker)

Cat. Derm. Salt. Brit. Mus. 1, p. 46 *Gryllus*) (1869);
Gryllus punctulipes Walker, loc. cit. p. 51 (1869).

Dist. Ceylon : Colombo, Kotte, Battaramulla, Kollonnawa, Ratmalana (Western Province); Peradeniya (Central Province); Kalawewa (North Central Province); Balangoda, Kitulgala (Sabaragamuwa Province); Bibile (Uva Province); Trincomalee, Batticoloa, Mahaoya (Eastern Province); Galle (Southern Province); Asia; Africa, Australia; West Indies: Mexico and South America.

Type in the British Museum (Natural History). *Type-locality* 'Swan River'.

25. *Gryllodes supplicans* (Walker)

Ann. Mag. Nat. Hist. (3) iv, p. 221 (*Acheta*) (1859); *Gryllus supplicans* Chopard, loc. cit. (9) xv, p. 510 (1925); *Gryllodes greeni* Chopard, loc. cit. (9) xv, p. 511, fig. 5 (1925). *Type-locality* 'Ceylon' (male & female); Chopard, Ceylon J. Sci. (B) xx, p. 28 (1936).

Dist. Ceylon : Matale (Central Province); Balangoda (Sabaragamuwa Province); Bandarawela (Uva Province).

Type in the British Museum (Natural History). *Type-locality* 'Ceylon'.

Genus Gryllopsis Chopard

Rec. Ind. Mus. xxx, p. 13 (1928).

26. *Gryllopsis falconneti* (Saussure)

Mém. Soc. Geneve, xxv, p. 230 (*Gryllodes* (1877); Chopard, Ceylon J. Sci. (B) xx, p. 28 (1936).

Dist. Ceylon : Recorded by W. F. Kirby without exact locality; India.

Type in the Paris Museum. *Type-locality* 'Central India'. This species is not represented in the Colombo Museum collection.

Genus Nemobiodes Chopard.

Ann. Soc. Ent. Fr. lxxxvi, p. 521 (1918).

27. *Nemobiodes laeviceps* Chopard

Ann. Mag. Nat. Hist. (9) xv, p. 515 (1925); *Nemobiodes ceylonicus* Chopard, Ceylon J. Sci. (B) xiv, p. 199, figs. 3-4 (1928). Type locality Urugala, Ceylon, September 1922; Chopard, Ceylon J. Sci. (B) xv, p. 29 (1936).

Dist. Ceylon : Woodside Urugala (Central Province); Pulmoddai (Eastern Province).

Type (male) in the British Museum (Natural History). *Type-locality* 'Ceylon'. No precise locality (E. E. Green).

28. *Nemobiodes nigrocephalus* Chopard

Ann. Mag. Nat. Hist. (9) xv, p. 514, fig. 6 (1925).

Dist. Ceylon : Peradeniya, Matale, Mousakande Gammaguwa, Hakgala (Central Province); Bintenne (Uva Province).

Type (male) in the British Museum (Natural History). *Type-locality* Peradeniya, June 1905 (E. E. Green).

Genus Cophogryllus Saussure

Mém. Soc. Geneve, xxv, p. 232 (1877).

29. *Cophogryllus martini* Bolivar

Ann. Soc. Ent. Fr. lxviii, p. 708 (1900); Chopard, Ann. Mag. Nat Hist. (9) xv, p. 515, fig. 7 (1925).

Dist. Ceylon: Sigiriya (Central Province); Continental India.

Type in the Paris Museum. *Type-locality* Trichinopoly. This species is not represented in the Colombo Museum.

Genus Scapsipedus Saussure

Mém. Soc. Geneve, xxv, p. 239 (1877).

30. *Scapsipedus aspersus* (Walker)

Cat. Derm. Salt. Brit. Mus. 1, p. 39 (*Gryllus*) (1869); *Gryllodes berthellus* Saussure, Mém. Soc. Geneve, xxv, p. 205(1877); *Gryllus berthellus* Chopard, Ann. Mag. Nat. Hist. (9) xv, p. 510 (1925); *Scapsipedus mandibularis* Saussure Mém. Soc. Geneve, xxv, p. 246 (1877); Ceylon J. Sci. (B) xx, p. 29 (1936).

Dist. Ceylon: Colombo, Kotte, Battarmulla (Western Province); Kandy, Peradeniya, Woodside Urugala (Central Province); Ratnapura, Balangoda (Sabaragamuwa Province); Bintenne, Bibile (Uva Province); Mahaoya (Eastern Province); Murunkan (Northern Province); Southern Asia.

Type in the British Museum (Natural History). *Type-locality* Hong Kong.

31. *Scapsipedus ceylonicus* Chopard

Rec. Ind. Mus. xxx, p. 18 (1928); Chopard, Ceylon J. Sci. (B). xx, p. 30 (1936).

Dist. Ceylon: Colombo, Battaramulla, Labugama (Western Province); Peradeniya (Central Province); Balangoda (Sabaragamuwa Province).

Type (male & female) in the Indian Museum. *Type-locality* Peradeniya, May 1910 (male) (E. E. Green); Labugama, November 1909 (female) (E. E. Green).

Genus Coiblemmus Chopard

Ceylon J. Sci. (B) xx, p. 30 (1936).

32. *Coiblemmus compactus* (Chopard)

Ceylon J. Sci. (B) xiv, p. 201, pl. xiii, figs. 5-6 (*Homaloblemmus*) (1928); *Homaloblemmus cavifrons* Chopard, Stylops ii, p. 116, fig. 3 (1933); Chopard, Ceylon J. Sci. (B) xx, p. 30 (1936).

Dist. Ceylon: Mihintale (North Central Province); Wellawaya, Bintenne (Uva Province); Trincomalee (Eastern Province); Yala (Southern Province); Elephant Pass, Vivuniya, Marichchukaddi (Northern Province); India.

Type in the British Museum (Natural History). *Type-locality* Elephant Pass, January 1923 (male) (G. M. Henry); Vavuniya, December 1923 (female) (G. M. Henry).

Genus LOXOBLEMMUS Saussure

Mém. Soc. Geneve, xxv, p. 249 (1877).

33. *Loxoblemmus equestris* Saussure

Mém. Soc. Geneve, xxv, p. 252, pl. 13 figs. 4, 4a-c (1877); Chopard, Ceylon J. Sci. (B) xx, p. 31 (1936).

Dist. Ceylon: Battaramulla, Hanwella (Western Province); Peradeniya, Mousakande Gammaduwa (Central Province); Rakwana (Sabaragamuwa Province); Bintenne (Uva Province); Southern Asia.

Type in the Leyden Museum. *Type-locality* Java.

34. *Loxoblemmus longipalpis* Chopard

Ceylon J. Sci. (B) xiv, p. 200 (1928); Chopard, Ceylon J. Sci. (B) xx, p. 31 (1936).

Dist. Ceylon: Colombo, Battaramulla (Western Province); Kandy (Central Province); Balangoda, Deniyaya, Timbolketiya, Madola Opanake (Sabaragamuwa Province); Bintenne (Uva Province); Mahaoya (Eastern Province); Katagamuwa, Talgasmankade, Warahamankade (Southern Province).

Type in the British Museum (Natural History). *Type-locality* Colombo, October 1919 (G. M. Henry).

Genus STEPHOBLEMMUS Saussure

Mém. Soc. Geneve, xxv, p. 259 (1877).

35. *Staphoblemmus humbertiellus* Saussure

Mém. Soc. Geneve, xxv, p. 260, pl. 13 figs. 1-3 (1877); Chopard, Ceylon J. Sci. (B) xx, p. 31 (1936).

Dist. Ceylon: Alutnuwara (Uva Province).

Type in the Paris Museum. *Type-locality* 'Mountains of Ceylon', (M. A. Humbert). This species is represented by a solitary male specimen in the Colombo Museum collection, and is the only specimen found since Saussure's description; the female is still unknown.

Genus SCAPSIPEDOIDES Chopard

Ceylon J. Sci. (B) xx, p. 32 (1936).

36. *Scapsipedoides macrocephalus* Chopard

Ceylon J. Sci. (B) xx, p. 32, fig. 4 (1936).

Dist. Ceylon: Belihuloya (Sabaragamuwa Province); Trincomalee (Eastern Province).

Type (male) in the Colombo Museum. *Type-locality* Belihuloya, September 1928 (G. M. Henry).

37. *Scapsipedoides apterus* Chopard

Ceylon J. Sci. (B) xx, p. 32 (1936).

Dist. Ceylon: Madola Opanake (Sabaragamuwa Province); Bandarawela (Uva Province).

Type (male) in the Colombo Museum. *Type-locality* Madola near Opanake, February 1933 (G. M. Henry).

Genus LANDREVA Walker

Cat. Derm. Salt. Brit. Mus. 1, p. 55 (1869).

38. *Landreva clara* (Walker)

Cat. Derm. Salt. Brit. Mus. 1, p. 39 (*Gryllus*) (1869); Chopard, Ann. Mag. Nat. Hist. (9) xv, p. 516, figs. 8–10 (1925).

Dist. Ceylon: Colombo, Battaramulla, Dehiwela, Labugama (Western Province); Marai Villu (North Western Province); Kandy, Peradeniya, Hakgala (Central Province); Randeniya, Wellawaya, Haldumulla, Bibile, Bintenne (Uva Province); Balangoda, Timbolketiya (Sabaragamuwa Province); Mahaoya (Eastern Province); Galle (Southern Province).

Type in the British Museum (Natural History). *Type-locality* ' Ceylon '.

39. *Landreva subaptera* Chopard

Ann. Mag. Nat. Hist. (9) xy, p. 517, fig. 11 (1925); Chopard, Ceylon J. Sci. (B) xx, p. 35 (1936).

Dist. Ceylon: Namunukula, Ohiya (Uva Province); Ratnapura (Sabaragamuwa Province); Hambantota (Southern Province).

Type (female) in the British Museum (Natural History). *Type-locality* Namunukula 6000 feet, November 1910 (E. E. Green).

40. *Landreva insignis* Walker

Cat. Derm. Salt. Brit. Mus. 1, p. 55 (1869); Chopard, Ceylon J. Sci. (B) xx, p. 35 (1936).

Dist. Ceylon: Labugama (Western Province): Mousakande Gammaduwa, Maskeliya (Central Province); Morningside Rakwana (Sabaragamuwa Province); India.

Type in the British Museum (Natural History). *Type-locality* ' Ceylon '.

41. *Landreva angustifrons* Chopard

Ceylon J. Sci. (B) xx, p. 36, fig. 5 (1936).

Dist. Ceylon: Labugama (Western Province); Mousakande Gammaduwa (Central Province).

Type (male) in the Colombo Museum. *Type-locality* Labugama, August 1932 (G. M. Henry).

Genus HEMILANDREVA Chopard

Ceylon J. Sci. (B) xx, p. 38 (1936).

42. *Hemilandreva lamellipennis* Chopard

Ceylon. J. Sci. (B) xx, p. 38, fig. 6 (1936).

Dist. Ceylon: Belihuloya (Sabaragamuwa Province); Mahaoya (Eastern Province).

Type (male) in the Colombo Museum. *Type-locality* Nonpareil Estate, Belihuloya 4000 feet, September 1928 (G. M. Henry).

Subfam. 3. **Nemobiinae**

Genus PARANEMOBIUS Saussure

Mém. Soc. Geneve, xxv, pp. 62–63 (1877).

43. *Paranemobius pictus* Saussure

Mém. Soc. Geneve, xxv, p. 67, pl. 11, figs. 1-3 (1877); Chopard, Ceylon, J. Sci. (B) xx, p. 41 (1936).

Dist. Ceylon: Labugama (Western Province); Peradeniya (Central Province); Kalawewa (North Central Province); Ratnapura, Kitulgala, Belihuloya (Sabaragamuwa Province); Oodoowerre Demodera (Uva Province); Mahaoya (Eastern Province); Hiniduma (Southern Province); Kallar (Northern Province); India.

Type in the Vienna Museum. *Type-locality* 'Cashmir'.

Genus *Pteronemobius* Jakobson

Orth. Pseudoneur. Russian Emp. p. 450 (1904).

44. *Pteronemobius concolor* (Walker)

Cat. Derm. Salt. Brit. Mus. v, suppl. p. 10 (*Eneoptera* (1871); *Nemobius ceylonicus* Saussure, Mém. Soc. Geneve, xxv, p. 86 (1877); *Pteronemobius gravelyi* Chopard, Rec. Ind. Mus. xxvii, p. 183 (1924); Chopard, Ceylon J. Sci. (B) xx, p. 42 (1936).

Dist. Ceylon; Colombo, Battaramulla, Kotte, Negombo (Western Province); Marai Villu (North Western Province); Kandy, Matale (Central Province); Kalawewa (North Central Province); Ratnapura, Yatiantota, Madola Opanake (Sabaragamuwa Province); Bintenne (Uva Province); Trincomalee (Eastern Province); Barberyn (Southern Province); Marichchukkaddi (Northern Province); Southern Asia.

Type in the British Museum (Natural History). *Type-locality* Bombay.

45. *Pteronemobius birmanus* Chopard

Ann. Soc. Ent. Fr. lxxxvi, p. 556, fig. 84 (1918); Chopard, Ceylon J. Sci. (B) xx, p. 42 (1936).

Dist. Ceylon: Colombo, Battaramulla (Western Province); India.

Type in the Genoa Museum. *Type-locality* 'Birmania'.

46. *Pteronemboius vagus* (Walker)

Cat. Derm. Salt. Brit. Mus. v, suppl. p. 10 (1871); Chopard, Ceylon J. Sci. (B) xv, p. 43 (1936).

Dist. Ceylon: Colombo, Kotte, Battaramulla (Western Province); Peradeniya (Central Province); Balangoda, Rakwana (Sabaragamuwa Province); Barberyn (Southern Province); Southern Asia.

Type in the British Museum (Natural History). *Type-locality* Bombay.

47. *Pteronemobius taprobanensis* (Walker)

Cat. Derm. Salt. Brit. Mus. 1, p. 102 (*Trigonidium*) (1869); *Eneoptera lateralis* Walker, loc. cit. v, suppl. p. 11 (1871); *Nemobius infernalis* Saussure, Mém. Soc. Geneve, xxv, p. 83 (1877); *Nemobius javanus* Saussure, loc. cit. p. 85 (1877); Chopard, Ceylon J. Sci. (B) xx, p. 43 (1936).

Dist. Ceylon: Colombo, Kotte, Battaramulla, Labugama (Western Province); Kandy, Peradeniya, Matale, Horton Plains, Hakgala (Central Province); Ratnapura, Kitulgala (Sabaragamuwa Province); Bandarawela, Ohiya (Uva Province); Trincomalee, Arugam Bay (Eastern Province); Southern Asia.

Type in the British Museum (Natural History). *Type-locality* 'Ceylon'.

48. *Pteronemobius fascipes* (Walker)

Cat. Derm. Salt. Brit. Mus. 1, p. 67 (*Eneoptera*) (1869); *Eneoptera alboatra* Walker, loc. cit. v, suppl. p. 11 (1877); *Nemobius histrio* Saussure, Mém. Soc. Geneve, xxv, p. 95 (1877); *Nemobius nigrosignatus* Brunner, Ann. Mus. Genoa, xxxiii, p. 196 (1893).

Dist. Ceylon: Colombo, Kotte, Battaramulla, Labugama (Western Province); Matale, Madugoda, Mousakande Gammaduva (Central Province); Bandarawela, North Punduluoya, Bintenne (Uva Province); Ratnapura (Sabaragamuwa Province); Hiniduma (Southern Province); Southern Asia.

Type in the British Museum (Natural History). *Type-locality* 'North Hindustan'.

49. *Pteronomobius csikii* (Bolivar)

Zichy Zool. Ergebn. ii, p. 248 (*Nemobius*) (1901); Chopard, Ann. Mag. Nat. Hist. (9) xv, p. 507 (1925).

Dist. Ceylon: Colombo, Battaramulla (Western Province); Kandy, Peradeniya (Central Province); Trincomalee, Mahaoya (Eastern Province); Southern Asia.

Type in the Vienna Museum. *Type-locality* China.

50. *Pteronemobius bicolor* (Saussure)

Mém. Soc. Geneve, xxv, p. 98, pl. 11, figs. 5-6 (*Nemobius*) (1877); Chopard, Ceylon J. Sci. (B) xx, p. 45 (1936).

Dist. Ceylon: Marai Villu (North Western Province); India.

Type in the Geneva Museum. *Type-locality* 'Central India'.

Genus Scottia Bolivar

Trans. Linn. Soc. London, xv, p. 278 (1912)

51. *Scottia ceylonica* Chopard

Ceylon J. Sci. (B) xx, p. 45, fig. 8 (1936).

Dist. Ceylon: Mousakande Gammaduwa, Hakgala, Nuwara Eliya (Central Province).

Type (female) in the Colombo Museum. *Type-locality* Nuwara Eliya, April 1931 (G. M. Henry).

Subfam. 4. **Trigonidiinae**

Genus TRIGONIDIUM Rambur

Faune Andal. ii, p. 39 (1839).

52. *Trigonidium cicindeloides* Rambur

Faune Andal. ii, p. 39 (1839); Chopard, Ann. Mag. Nat. Hist. (9) xv, p. 525 (1925).

Dist. Ceylon : Colombo (Western Province); Mousakande Gammaduwa (Central Province); Timbolketiya (Sabaragamuwa Province); Bandarawela, Bintenne (Uva Province); Pullumalai (Eastern Province); Katagamuwa, Ranna (Southern Province); Asia; Australia; Africa.

Type in the British Museum (Natural History). *Type-locality* 'Ceylon'.

53. *Trigonidium humbertianum* (Saussure)

Mém. Soc. Geneve, xxv, p. 468, pl. 17, fig. 1 (*Homoeoxiphus*) (1878); Chopard, Ann. Mag. Nat. Hist. (9) xv, p. 525 (1925).

Dist. Ceylon : Colombo, Battaramulla (Western Province); Chilaw (North Western Province); Kandy, Peradeniya (Central Province); Kalawewa (North Central Province); Timbolketiya (Sabaragamuwa Province); Trincomalee, Kalkudah (Eastern Province); Yala, Talgasmankada (Southern Province); Southern Asia.

Type in the Geneva Museum. *Type-locality* Trincomalee (M.A. Humbert).

Genus METIOCHE Stål

Ofvers. Vet-Akad. Förh. xxxiv, p. 48 (1877);

Piestoxiphus Saussure, Mém. Soc. Geneve, xxx, p. 467 (1878).

54. *Metioche unicolor* Chopard

Ann. Mag. Nat. Hist. (9) xv, p. 526, fig. 22 (1925); Chopard, Ceylon J. Sci. (B) xx, p. 49 (1936).

Dist. Ceylon: Colombo (Western Province); Peradeniya (Central Province); Malay Archipelago.

Type (male) in the British Museum (Natural Hisiory), (female) in the Chopard collection. *Type-locality* Peradeniya. December 1910 (male) (E. E. Green); Batavia, August 1920 (female) (H. Karny).

Genus METIOCHODES Chopard

Ark. f. Zool. 23A, No. 9, p. 13 (1932).

55. *Metiochodes greeni* (Chopard)

Ann. Mag. Nat. Hist. (9) xv, p. 532, fig. 26 (*Cyrtoxipha*) (1925); Chopard, Ceylon J. Sci. (B) xx, p. 49, fig. 9 (1936).

Dist. Ceylon: Colombo, Labugama (Western Province); Peradeniya (Central Province); Ratnapura (Subaragamuwa Province); Galge (Uva Province); Arugam Bay (Eastern Province).

Type in the British Museum (Natural History). *Type-locality* Peradeniya, June 1910 (E. E. Green).

56. *Metiochodes trilineatus* Chopard

Ceylon J. Sci. (B) xx, p. 50, fig. 10 (1936).

Dist. Ceylon: Rangala (Central Province).

Type (female) in the Colombo Museum. *Type-locality* St. Martin's Estate, Rangala, April 1930 (G. H. Henry).

Genus AMUSURGUS Brunner

Ann. Mus. Genova, xiii, pp. 207, 212 (1893).

57. *Amusurgus oedemeroides* (Walker)

Cat. Derm. Salt. Brit. Mus. v, suppl. p. 11 (*Eneoptera*) (1871); *Amusurgus fulvus* Brunner, Ann. Mus. Genova, xiii, p. 212 (1893). Type locality 'Birma'; Chopard, Ann. Mag. Nat. Hist. (9) xv, p. 527, fig. 23 (1925).

Dist. Ceylon: Colombo, Battaramulla, Labugama, (Western Province); Kandy, Matale, Woodside Urugala, Rangala, Nitre Cave Medamahanuwara (Central Province); Madawachiya (North Central Province); Ratnapura, Rakwana, Kitulgala Madola Opanake (Sabaragamuwa Province); Wellawaya (Uva Province); Kanniyai Trincomalee, Mahaoya (Eastern Province); Vavuniya (Northern Province); India; Burma; Malay Archipelago.

Type in the British Museum (Natural History). *Type-locality* 'Ceylon'.

58. *Amusurgus speculifer* Chopard

Ceylon J. Sci. (B) xx, p. 52, fig. 11 (1936).

Dist. Ceylon: Labugama (Western Province).

Type (male) in the Colombo Museum. *Type-locality* Labugama, March 1931. (G. M. Henry).

Genus PARANAXIPHA Chopard

Ann. Mag. Nat. Hist. (9) xv, p. 530 (1925).

59. *Paranaxipha ornatipes* Chopard

Ann. Mag. Nat. Hist. (9) xv, p. 528, fig. 24 (1925).

Dist. Ceylon: Labugama (Western Province); Kandy, Sigiriya, Woodside Urugalla, Nitre Cave Medamahanuwara (Central Province); Mihintale (North Central Province); Ratnapura (Sabaragamuwa Province); Wellawaya, Haldumulla (Uva Province); Kanniyai Trincomalee (Eastern Province).

Type in the British Museum (Natural History). *Type-locality* Kandy, June 1910 (E. E. Green).

Genus TRIGONIDOMORPHA Chopard

Ark. f. Zool. 18A, No. 6, p. 39 (1926).

60. *Trigonidomorpha fuscifrons* Chopard

Ceylon J. Sci. (B) xx, p. 54, fig. 12 (1936).

Dist. Ceylon: Bandarawela (Uva Province).

Type (male) in the Colombo Museum. *Type-locality* Bandarawela, April 1931 (G. M. Henry).

Genus HOMOEOXIPHA Saussure

Miss. Méx. Orth. p. 363 (1874).

61. *Homoeoxipha lycoides* (Walker)

Cat. Derm. Salt. Brit. Mus. 1, p. 71 (*Phyllopalpus*) (1869); *Homoeoxipha histrio* Saussure, Mém. Soc. Geneve, xxv, p. 467 (1878); *Cyrtoxipha ritsemae* Saussure, loc. cit. p. 485 (1878); Chopard, Ann. Mag. Nat, Hist. (9) xv, p. 532 (1925).

Dist. Ceylon; Colombo, Kotte, Labugama (Western Province); Kandy, Peradeniya, Matale (Central Province); Kalawewa (North Central Province); Ratnapura (Sabaragamuwa Province); Badulla, Wellawaya, Punduluoya, Galge, Haputale (Uva Province); Mahaoya (Eastern Province); Hiniduma, Katagamuwa (Southern Province); Marichchukaddi (Northern Province); Southern Asia.

Type in the British Museum (Natural History). *Type-locality* 'Ceylon'.

Genus ANAXIPHA Saussure

Miss. Méx. Orth. p. 370 (1874).

62. *Anaxipha pubescens* Chopard

Ann. Mag. Nat. Hist. (9) xv, p. 530, fig. 25 (1925); Chopard, Ceylon, J. Sci. (B) xx, p. 50 (1936).

Dist. Ceylon: Peradeniya (Central Province).

Type (male) in the British Museum (Natural History). *Type-locality* Peradeniya, December 1910 (E. E. Green). This species is not represented in the collection of the Colombo Museum.

63. *Anaxipha longipennis* (Serville)

Hist. Nat. Ins. Orth. p. 351 (*Trigonidium*) (1839); *Cyrtoxiphus pusillus* Saussure, Mém. Soc. Geneve, xxv, p. 486 (1878); Chopard, Ann. Mag. Nat. Hist. (9) xv, p. 530 (1925); Chopard, Ceylon J. Sci. (B) xx, p. 57 (1936).

Dist. Ceylon: Colombo, Battaramulla, Dehiwela (Western Province); Marai Villu (North Western Province); Peradeniya, Matale (Central Province); Yatiantota, Kitulgala (Sabaragamuwa Province); Arugam Bay (Eastern Province); Ranna (Southern Province); Marichchukaddi (Northern Province); Asia; Australia; Africa.

Type in the Paris Museum. *Type-locality* Mauritius.

64. *Anaxipha henryi* Chopard

Ceylon J. Sci. (B) xx, p. 57 (1936).

Dist. Ceylon: Bandarawela, Wellawaya (Uva Province); Tirukovil, Arugam Bay (Eastern Province).

Type (male) in the Colombo Museum. *Type-locality* Wellawaya April 1931 (G. M. Henry).

Subfam. 5. **Myrmecophilinae**

Genus MYRMECOPHILA Latreille

Regne Anim. (ed. 2) v, p. 183 (1829); *Myrmecophilus* Saussure, Mém. Soc. Geneve, xxv, p. 289 (1877).

65. *Myrmecophila escherichi* Schimmer

Termit. auf. Ceylon, p. 235, fig. 61 (1911), Chopard, Ceylon J. Sci. (B) xx, p. 58 (1936).

Dist. Ceylon: No precise locality is indicated.

This species was described from a very young larva 1.6 mm. long. It is not represented in the collection of the Colombo Museum.

Genus MYRMOPHILELLUS Uvarov

Ann. Mag. Nat. Hist. (11) vi, p. 113 (1940).

66. *Myrmophilellus pilipes* (Chopard)

Rec. Ind. Mus. xxx, p. 21, fig. 30 (*Myrmegryllus*) (1928); *Myrmecophila dubia* Chopard (nec Saussure), Ann. Mag. Nat. Hist. (9) xv, p. 519 (1925); Chopard, Ceylon J. Sci. (B) xx, p. 59 (1936).

Dist. Ceylon: Colombo, Battaramulla (Western Province); Peradeniya, Mousakande Gammaduwa (Central Province); Bandarawela, Bibile, Oodoowerre Demodera (Uva Province).

Type (male) in the Indian Museum. *Type-locality* Peradeniya, May 1910 (E. E. Green).

Subfam. 6. **Mogoplistinae**

Genus CYCLOPTILOIDES Sjoestedt

Ergeb. Schwed. Exp. Kilimandjaro, iii (17), pp. 94, 109 (1909).

67. *Cycloptiloides orientalis* Chopard

Ann. Soc. Ent. Fr. xciv, p. 301, figs. 19–24 (1925); *Cycloptiloides ceylonicus* Chopard, Ann, Mag. Nat. Hist. (9) xv, p. 520, figs. 13–14 (1925). Type locality Peradeniya, Ceylon (male); Chopard, Ceylon J. Sci. (B) xx, p. 60 (1936).

Dist. Ceylon: Battaramulla (Western Province); Peradeniya, Mousakande Gammaduwa (Central Province); Bandarawela, Bibile, Oodoowerre Demodera (Uva Province); Malay Archipelago.

Type in the Paris Museum. *Type-locality* Sumatra.

Genus ORNEBIUS De Guérin

Mém. Icon. Anim. Ins. iii, p. 331 (1844).

68. *Ornebius guerini* (Bolivar)

Ann. Soc. Ent. Fr. lxviii, p. 801 (*Liphoplus*) (1900); *Liphoplus ceylonicus* Chopard, Ann. Mag. Nat. Hist. (9) xv, p. 519, fig 12 (1925). Type locality Peradeniya, Ceylon (female); Chopard, Ceylon J. Sci. (B) xx, p. 60 (1936).

Dist. Ceylon: Kandy, Peradeniya (Central Province); Wellawaya (Uva Province); Trincomalee (Eastern Province); Yala (Southern Province); India.

Type in the Paris Museum. *Type-locality* ' South India '.

69. *Ornebius varipennis* Chopard

Ceylon J. Sci. (B) xx, p. 60 (1936).

Dist. Ceylon: Madugoda (Central Province); Polonnaruwa (North Central Province); Wellawaya (Uva Province); Tennamarawadi Trincomalee (Eastern Province); Marichchukaddi (Northern Province).

Type (male, in the Colombo Museum. *Type-locality* Marichchukaddi, March 1933 (G. M. Henry).

Genus DERECTAOTUS Chopard

Ceylon J. Sci. (B) xx, p. 61 (1936).

70. *Derectaotus ceylonicus* (Chopard)

Rec. Ind. Mus. xxx, p. 24, figs. 34 & 39 (*Ornebius*) (1928); Chopard, Ceylon J. Sci. (B) xx, p. 62 (1936).

Dist. Ceylon: Kandy, Mousakande Gammaduwa (Central Province).

Type (female) in the Indian Museum. *Type-locality* Kandy, June 1910 (E. E. Green).

71. *Derectaotus henryi* (Chopard)

Ceylon J. Sci. (B) xiv, p. 203, pl. 14, figs. 11–12 (*Cryptoptilum*) (1928); Chopard, Ceylon J. Sci. (B) xx, p. 62 (1936).

Dist. Ceylon: Kandy (Central Province); Herowupotana (North Central Province); Kanniyai Trincomalee (Eastern Province); Warahamankada (Southern Province).

Type (male) in the British Museum (Natural History). *Type-locality* Horowupotana, October 1924 (G. M. Henry).

72. *Derectaotus palpatus* Chopard

Ceylon J. Sci. (B) xx, p. 62 (1936).

Dist. Ceylon: Hakgala, Mousakande Gammaduwa, Goatfell Kandapola (Central Province).

Type (male) in the Colombo Museum. *Type-locality* Hakgala, August 1929 (G. M. Henry).

Genus ECTATODERUS De Guérin

Lefebvre, Voy. Abyssin. vi, p. 336 (1849).

73. *Ectatoderus ceylonicus* Chopard

Ceylon: J. Sci. (B). xiv, p. 202, pl. 14, figs. 7–10 (1928); Chopard, Ceylon J. Sci. (B) xx, p. 63 (1936).

Dist. Ceylon: Horowupotana (North Central Province); Kalkudah (Eastern Province); Barberyn, Vilapalawewa (Southern Province).

Type in the British Museum (Natural History). *Type-locality* Horowupotana, October 1924 (G. M. Henry).

Subfam. 7. **Pentacentrinae**

Genus PENTACENTRUS Saussure

Mèm. Soc. Geneve, xxv, p. 399 (1878).

74. *Pentacentrus pulchellus* Saussure

Mém. Soc. Geneve, xxv, p. 401, pl. 17, figs. 1–5 (1878); Chopard, Ann. Mag. Nat. Hist. (9) xv, p. 523, fig. 18 (1925).

Dist. Ceylon: Mousakande Gammaduwa, Maskeliya (Central Province). *Type* in the Berlin Museum. *Type-locality* ‘Ceylon’.

Genus HOMALOGRYLLUS Chopard

Ann. Mag. Nat. Hist. (9) xv, p. 525 (1925).

75. *Homalogryllus depressus* Chopard

Ann. Mag. Nat. Hist. (9) xv, p, 523, figs. 19-21 (1925).

Dist. Ceylon: Trincomalee (Eastern Province).

Type (male) in the British Museum (Natural History). *Type-locality* Trincomalee, January 1912 (E. E. Green). This species is not represented in the Colombo Museum collection. Known from the type-specimen only.

Subfam. 8. **Oecanthinae**

Genus OECANTHUS Serville

Ann. Sci. Nat. xxii, p. 134 (1831); *Aecanthus* Brulle, Hist. Nat. Ins. ix, p. 174 (1835).

76. *Oecanthus indicus* Saussure

Mém. Soc. Geneve, xxv, p. 451 (1878); Chopard, Ann. Mag. Nat. Hist. (9) xv, p. 523 (1925).

Dist. Ceylon: Colombo: (Western Province); Peradeniya, Mousakande Gammaduwa (Central Province); Rakwana (Sabaragamuwa Province); Haldumulla, Bintenne (Uva Province); Nirodumunai, Trincomalee (Eastern Province); Ranna, Vilapalawewa (Southern Province); India; Malay Archipelago; Formosa.

Type in the Paris Museum. *Type-locality* Bombay.

77. *Oecanthus rufescens* Serville

Hist. Nat. Ins. Orth. p. 361 (1839); Chopard, Ceylon J. Sci. (B) xx, p. 65 (1936).

Dist. Ceylon: Bandarawela (Uva Province); India; Malay Archipelago; Australia.

Type in the Paris Museum. *Type-locality* Bombay.

78. *Oecanthus henryi* Chopard

Ceylon J. Sci. (B) xx, p. 65 (1936).

Dist. Ceylon: Colombo, Battaramulla (Western Province); Kalawewa (North Central Province); Wellawaya (Uva Province); Pullumalai (Eastern Province); Deniyaya (Southern Province); Marichchukaddi (Northern Province).

Type (male) in the Colombo Museum. *Type-locality* Wellawaya, July 1930 (G. M. Henry).

Subfam. 9. **Phalangopsinea**

Genus ARACHNOMIMUS Saussure

Biol. Centr. Amer., Zool., Orth. 1, p. 251 (1897).

79. *Arachnomimus nietneri* (Saussure)

Mém. Soc. Geneve, xxv, p. 442 (*Arachnopsis*) (1878); Chopard, Ann. Mag. Nat. Hist. (9) xv, p. 522 (1925).

Dist. Ceylon: Labugama (Western Province); Peradeniya, Mousakande Gammaduwa, Ohiya, West Haputale, Hakgala (Central Province); Polonnaruwa (North Central Province); Wellawaya, Bintenne, Kalugala, Nammunukula (Uva Province); Trincomalee (Eastern Province).

Type in the Berlin Museum. *Type-locality* 'Ceylon'.

80. *Arachnomimus bicolor* Chopard

Ceylon J. Sci. (B) xiv, p 205., pl. 15, 15–17 (1928); Chopard, Ceylon J. Sci. (B) xx, p. 66 (1936).

Dist. Ceylon: Horowupotana (North Central Province); Vavuniya Northern Province).

Type in the British Museum (Natural History). *Type-locality* Horowupotana October 1924 (male) (G. M Henry); Vavuniya, December 1923 (female) (G. M. Henry). This species is not represented in the Colombo Museum collection.

81. *Arachnomimus annulicornis* Chopard

Ceylon J. Sci. (B) xx, p. 67, fig. 13 (1936).

Dist. Ceylon: Bintenne, Buttala (Uva Province).

Type (male) in the Colombo Museum. *Type-locality* Buttala, October 1931 (G. M. Henry).

Genus Luzaropsis Chopard

Ann. Mag. Nat. Hist. (9) xv, p. 521 (1925).

82. *Luzaropsis ferruginea* (Walker)

Cat. Derm. Salt. Brit. Mus. 1, p. 103 (*Luzara*) (1869); Chopard, Ann. Mag. Nat. Hist. (9) xv, p. 521, figs. 15-17 (1925).

Dist. Ceylon: Labugama (Western Province); Kandy, Woodside Urugala, Mousakande Gammaduwa (Central Province); Balangoda, Kitulgala, Rakwana, Timbolketiya, Opanake (Sabaragamuwa Province); Wellawaya, North Punduluoya, Haputale, Haldumulla (Uva Province); Deniyaya, Hiniduma (Southern Province); Vavuniya (Northern Province),

Type in the British Museum (Natural History). *Type-locality* 'Ceylon'.

83. *Luzaropsis henryi* Chopard

Ceylon J. Sci. (B) xiv, p. 203, pl. 15, figs. 13-14 (1928); Chopard, Ceylon J. Sci. (B) xx, p. 68 (1936).

Dist. Ceylon: Horowupotana, Polonnaruwa, Mihintale (North Central Province); Trincomalee, Pulmoddai, Katalai (Eastern Province); (Marichchukaddi (Northern Province).

Type in the British Museum (Natural History). *Type-locality* Horowupotana, October 1924 (G. M. Henry).

Genus Seychellesia Bolivar

Trans. Linn. Soc. London, xv, p. 286 (1912).

84. *Seychellesia ceylonica* Chopard

Ceylon J. Sci. (B) xx, p. 69. figs. 14-15 (1936).

Dist. Ceylon: Labugama (Western Province); Timbolketiya (Sabaragamuwa Province); Deniyaya (Southern Province).

Type (male) in the Colombo Museum. *Type-locality* Labugama, January 1930 (G. M. Henry).

Subfam. 10. **Itarinae**

Genus Heterotrypus Saussure

Mém. Soc. Geneve, xxv, pp. 506, 537 (1878).

85. *Heterotrypus vicinus* Chopard

Ceylon J. Sci. (B) xiv, p. 206, pl. 16, figs. 18-22 (1928); Chopard, Ceylon J. Sci. (B) xx, p. 71 (1936).

Dist. Ceylon: Labugama (Western Province); Urugala (Central Province); Kitulgala, Madola Opanake (Sabaragamuwa Province); Wellawaya, Bibile (Uva Province).

Type in the British Museum (Natural History). *Type-locality* Urugala, April 1924 (G. M. Henry).

86. *Heterotrypus elegans* Chopard

Ceylon J. Sci (B) xx, p. 72, figs. 16-17 (1936).

Dist. Ceylon: Labugama (Western Province); Kitulgala, Belihuloya, Rakwana, Madola Opanake (Sabaragamuwa Province); Deniyaya (Southern Province).

Type (male) in the Colombo Museum. *Type-locality* Kitulgala, April 1927 (G. M. Genry).

Subfam. 11. **Eneopterinae**

Genus CARDIODACTYLUS Saussure

Mém. Soc. Geneve, xxv, p. 517 (1878).

87. *Cardiodactylus praecipuus* (Walker)

Cat. Derm. Salt. Brit. Mus. 1, p. 83 (*Platydactylus*) (1869); *Madasumma praecipua* Chopard, Ann. Mag. Nat. Hist. (9) xv, p. 533 (1925); Chopard, Ceylon J. Soc. (B) xx, p. 75 (1936).

Dist. Ceylon: No precise locality mentioned. Recorded by F. Walker.

Type in the British Museum (Natural History). *Type-locality* 'Ceylon'. Known only from the type specimen, and the species has never been found since it was first described. This species is not represented in the Colombo Museum collection.

Subfam. 12. **Podoscirtinae**

Genus MADASUMMA Walker

Cat. Derm. Salt. Brit. Mus. 1, p. 64 (1869).

88. *Madasumma marginipennis* (De Guèrin)

Mém. Icon. Anim. Ins. iii, p. 330 (*Platydactylus*) (1844); Chopard, Ann. Mag. Nat. Hist. (9) xv, p. 533 ((1925).

Dist. Ceylon: Colombo, Battaramulla, Dehiwela, Wadduwa (Western Province); Marai Villu (North Western Province); Kandy, Peradeniya, Mousakande Gammaduwa, Woodside Urugala (Central Province); Balangoda, Timbolketiya, Rakwana (Sabaragamuwa Province); Bandarawela, Wellawaya, Uva Highlands, Bintenne Madulsima, Buttala, Tellula, Kudaoya (Uva Province); Kantalai, Mahaoya (Eastern Province); Yala, Warahamankada, (Southern Province); Marichchukaddi (Northern Province).

89. *Madasumma greeni* Chopard

Ann. Mag. Nat. Hist. (9) xv, p. 533, figs. 27b, 29, 31 (1925); Chopard, Ceylon J. Sci. (B) xx, p. 76 (1936).

Dist. Ceylon: Kandy, Matale, Blahara (Central Province); Rakwana (Sabaragamuwa Province).

Type in the British Museum (Natural History). *Type-locality* Kandy May 1909 (E. E. Green).

90. *Madasumma albonotata* Chopard

Ceylon J. Sci. (B) xx, p. 78, fig. 18 (1936).

Dist. Ceylon : Kitulgala (Sabaragamuwa Province).

Type (male) in the Colombo Museum. *Type-locality* Kitulgala, April 1927 (G. M. Henry).

91. *Madasumma valida* Chopard

Ceylon J. Sci. (B) xx, p. 78, fig. 19 (1936).

Dist. Ceylon : Labugama (Western Province).

Type (male) in the Colombo Museum. *Type-locality* Labugama, June 1932 (G. M. Henry).

92. *Madasumma varipennis* (Walker)

Cat. Derm. Salt. Brit. Mus. 1, p. 84 (*Platydactylus*) (1869) ; *Madasumma incerta* Chopard, Ceylon J. Sci. (B) xiv, p. 205 (1928). Type locality Horowupotana, Ceylon (female); Chopard, Ceylon J. Sci. (B) xx, p. 79 (1936).

Dist. Ceylon: Horowupotana (North Central Province); Vilapalawewa (Southern Province) ; Marichchukaddi (Northern Province).

Type (male) in the British Museum (Natural History). *Type-locality* 'Ceylon'.

Genus Mnesibulus Stål

Ofvers. Vet.-Akad. Forh. xxxiv, p. 50 (1877).

93. *Mnesibulus pallipes* Chopard

Ceylon J. Sci. (B) xx, p. 81, figs. 21–22 (1936).

Dist. Ceylon : Sigiriya (Central Province) ; Madola Opanake (Sabaragamuwa Province).

Type (male) in the Colombo Museum. *Type-locality* Madola near Opanake, February 1933 (G. M. Henry).

Genus Euscyrtus De Guérin

Mém. Icon. Anim. Ins. iii, p. 334 (1844).

94. *Euscyrtus hemelytrus* (De Haan)

Temm. Verh. Orth. p. 231, pl. 20, fig. 2 (*Gryllus*) (1842) ; Chopard, Ceylon J. Sci. (B) xx, p. 82 (1936).

Dist. Ceylon : Battaramulla, Labugama (Western Province) ; Kandy (Central Province); Ratnapura (Sabaragamuwa Province); Mahaoya (Eastern Province); Udugama (Southern Province); Southern Asia.

95. *Euscyrtus concinnus* (De Haan)

Temm. Verh. Orth. p. 231, pl. 20, fig. 3 (*Gryllus*) (1842) ; Chopard, Ceylon J. Sci. (B) xx, p. 83 (1936).

Dist. Ceylon : Colombo, Battaramulla, Labugama (Western Province); Kandy, Hāragama, Peradeniya (Central Province); Anuradhapura, Mihintale (North Central Province); Ratnapura, Kitulgala (Sabaragamuwa Province) ; Haputale, Galge, Oodoowerre Demodera (Uva Province); Trincomalee, Andankulam (Eastern Province); Ambalangoda, Deniyaya (Southern Province) ; Marichchukaddi (Northern Province) ; Southern Asia.

96. *Euscyrtus necydaloides* (Walker)

Cat. Derm. Salt. Brit. Mus. v, suppl. p. 15 (*Oecanthus*) (1871); Chopard, Ann. Mag. Nat. Hist. (9) xv, p. 535 (1925).

Dist. Ceylon: Labugama (Western Province); Peradeniya (Central Province); Kitulgala (Sabaragamuwa Province).

Type in the British Museum (Natural History). *Type-locality* 'Ceylon'.

97. *Euscyrtus laminifer* Chopard

Ceylon J. Sci. (B) xx, p. 83 (1936).

Dist. Ceylon: Labugama (Western Province).

Type (male) in the Colombo Museum. *Type-locality* Labugama, September 1931 (G. M. Henry). Besides the type and allotype, the Colombo Museum collection contains sixteen specimens from the same locality.

98. *Euscyrtus perforatus* Chopard

Ceylon J. Sci. (B) xx, p. 84 (1936).

Dist. Ceylon: Colombo (Western Province).

Type (male) in the Colombo Museum. *Type-locality* Colombo, April 1931 (G. M. Henry)

Genus PATISCUS Stål

Ofvers. Vet.—Akad. Forh. xxxiv, p. 51 (1877).

99. *Patiscus quadripunctatus* Bolivar

Ann. Soc. Ent. Fr. lxviii, p. 806 (1900).

Dist. Ceylon: Haputale (Uva Province); India.

Type in the Pantel collection. *Type-locality* 'South India'.

OBITUARIES

SIR PETER CLUTTERBUCK

On the 20th of December 1951, at the age of 84, Sir Peter Clutterbuck, late Inspector-General of Forests of India and Burma, and late Chief Conservator of Forests, Kashmir, died at Bournemouth after a few hours' illness. To hundreds he was known simply as 'Clutter'; to thousands he was known and loved as 'Sir Peter'; to me he was the best friend a boy or a man ever had, a wonderful father.

Few who knew him will consider it filial exaggeration to describe him as a most remarkable man. Not only had he exceptional abilities in the wide varieties of activities of a forest officer's calling, but he was an administrator of great vision and tremendous faith. But here in the *Journal* it is more fitting to recall his activities as a shikari, a naturalist, an animal and bird lover, and a botanist, since others elsewhere have paid tribute to his prowess as a forest officer.

It was his love of animals and birds and natural history that took him to India. As a boy he was never happier than out in the open, birds' nesting or trapping rabbits. His school prizes—before me as I write—were all books on Natural History. So it was, after his time at Cooper's Hill, that in 1887 he landed in Bombay and found himself posted to the Central Provinces. His first station was Chanda, and he often told me how lucky he was in having as Conservator a man who said that shikar was the only way to get to know the immense forests of that area, which then were unmapped and without working plans. Shikar, his Conservator said, would take him miles off the beaten track and enable him to get to learn his territory as no other method could. He plunged wholeheartedly into this new life with an enthusiasm and zest that never left him. He was a man of tremendous strength, untiring, and with an amazing digestion and an ability to sleep at any time whenever the chance offered. He often recalled his early years and the amazing observation and prowess of the Gond trackers. On occasions he would spend days and nights continuously with his trackers following a bison or buffalo, always keeping well behind it, to study its habits: where it fed and what it fed on and when and where it drank and slept. He prepared his first working plans of Chanda, and it was here that he made his legendary walk of 64 miles in 16 hours. He was at some far forest of his Division when he got news that a man-eating tiger was interfering with his fire guards at Allapilli. These were the most valuable teak forests in the area and had been saved from fire for many years. It was the height of the hot weather. He wasted no time and started off at 4 o'clock in the afternoon with men carrying his water and big rifle. He walked solidly all through the night changing the carriers at intervals. He reached Allapilli at 8 o'clock the following morning. Alas, fever set in and it was not till some weeks later that he accounted for the man-eater. But his presence reassured the fire guards and no fires occurred. This walk is spoken of till this day and indicates well his energy, his enthusiasm and vigour.

It was here in Chanda that he met Winifred the daughter of the Superintendent of Police, A. B. W. Marriott, and got engaged to her. Shortly afterwards he was transferred to Gorakhpur in the U.P. and returned to Chanda the following year for his marriage. That was in 1896. He had been in India 9 years.

At Gorakhpur in 1897 and 1898 his first two sons were born and happy years were these for this young family as he was only 30 then, and my mother only 20.

But here in the U.P. forest life and work was different. First there were elephants for use which had not been the case in the C.P.; then the forests were heavier, more developed and richer. But they were no less rich in game than the C.P., and still the rifle was his constant companion. He had become an amazing shot. To such an extent was he sure of himself that he could never quite understand someone else's doubt after taking a shot and not knowing whether he had hit or missed his mark. On one occasion he brought back on the pad of his elephant 3 panthers that he had shot before breakfast. My mother was his constant companion and went with him into camp in October, not returning to their station till the following rains. In the hot weather they used to march early, and she got used to the orders to the Mahouts for the following morning '*Hāthi chār bajay*'. This later became a family saying for any early start.

As the years passed, so my father's love of shikar diminished. Perhaps it was the big viceregal shoots and Governors' shoots, in which he often worked the line of 30 or 40 elephants up to the guns and then had the job of dealing with wounded tigers, that tired him. He gradually gave up his rifle and took to his field glasses and gradually began to study birds. In his last 34 years birds were his greatest interest outside his work and home. After birds came fishing, of which he loved enormously the mahseer and the trout.

As he advanced in his service so was his work more administrative, and he was less able to spend time in his beloved forests. He always tried, however, to run a Christmas camp, and in 1918 I came out to India straight from France as a young subaltern of 20 and I can think of no happier period in my life than his Christmas camp on the Sarda River that winter. There I shot my first tiger, sambar and peafowl, and landed my first mahseer. The camp was at Kaldhuya. Day after day of perfect weather, mahseer fishing in that mighty river, the thrill of tying up for and sitting up for tiger, and the evenings round the huge camp fire listening to tales of the Indian jungle and forest lore. What heaven for a young man! Can it be wondered that I grew to love India as my father did?

After this came Simla and Delhi for him, and though he was happy promoting the interests of his beloved service he chafed at the office life and sought every means of escape from it. A walk with him from place to place was not along the contour or bridle path but straight down the khud and up again in a bee line. He could outwalk and outstay men of half his age.

He returned to England in 1925 after over 40 years service and it was thought that his Indian days were over. But no. He had always been troubled by asthma in England and his health got worse and worse. Finally in 1932 my mother sold their house, stored their belongings, and took him back to India for the winter where they had been invited as the guests of His Highness the Maharao of Kutch. The dry crisp air of Kutch worked wonders; so much so that in the following year he felt strong enough at the age of 66 to accept the post of Chief Conservator of Forests, Kashmir.

He took on a new lease of life and with undiminished vigour set about reorganising and developing the Forest Department of that rich State. He shot little, but for 13 golden years he revelled in his work, the joys of the wonderful home and garden my mother made, the study of birds, and fishing. He collected round him a band of enthusiastic officers and he spent his last years imparting to them all the knowledge and experience that he could, as he very early saw that it would be their task to carry on when he went. To the end he remained amazingly vigorous and seldom used his pony even on difficult tours. What he did for Kashmir and the Forest Department there would fill a volume. Though ageing, his vision and drive and enthusiasm were as great as ever.

He finally retired in 1945 and two years later celebrated his golden wedding of 60 happy years of married life. To the end he retained his amazing memory, his interest in India and her problems, and his love of nature, particularly of birds. His garden and the birds in it gave him joy. It is sad that he could not have lived another 6 months when he would have known that his eldest son would be shortly going to India as High Commissioner for Great Britain, that once again his blood would walk the land he loved and for which he strove all his life. How proud he would have been !

A very great man has passed away. *Hāthi chār bajay.*

J.E.C.

CHARLES M. INGLIS

(*Photo*)

By the death of C. M. Inglis at Coonoor on the 13th February 1954 the Society loses its second oldest member, and the world of ornithology one of its distinguished exponents.

Charles McFarlane Inglis, third son of Archibald William Inglis, indigo planter in North Bihar, India, was born at South College, Elgin, Scotland, on the 8th November 1870.

At the age of 17 Charles left school and went to Inverness, where he spent a year in the Traffic Office of the then Highland Railway. He loved Inverness but hated the job on an office stool. At that time his two elder brothers were indigo planting in North Bihar, India, and he longed to go out to that country.

He was fortunate to get a job as an assistant in January 1889 on the Roopacherra Tea Estate, in the Hailakandi District of Cachar. In those days the journey to Cachar was rather a long one, partly by boat and partly by river steamer, but it was all new and interesting.

Roopacherra, in those days, was an ideal spot for anyone interested in natural history, as there was heavy forest on some of its boundaries. Charles spent his leave days, Saturday afternoons and Sundays, in the forest, sleeping on a low machan beside some forest stream. The great ornithologist, A. O. Hume, had recently given up birds, and one of his collectors, a Mussulman, was wandering about the country looking for a job. He came to Roopacherra and showed Charles a beautifully made specimen of an oriole. Although the latter's monthly salary was only Rs. 125, he employed the man on Rs. 35 a month. At that time Stuart Baker was working in the North Cachar Hills and Charles soon got in touch with him, and then began a friendship which lasted throughout the rest of Stuart Baker's life. Books on Indian birds were Charles's difficulty as he could not afford them, but Baker kindly gave him what were necessary.

After 5 years at Roopacherra and 3 more in Larsingah Tea Garden in the Happy Valley, near Silchar, Charles finally gave up tea and joined his brothers in Bihar, and got a job there at Jainagar on the Nepal frontier. In 1898 he left for another job at Baghownie where he lived for 25 years, having bought up the place in 1900.

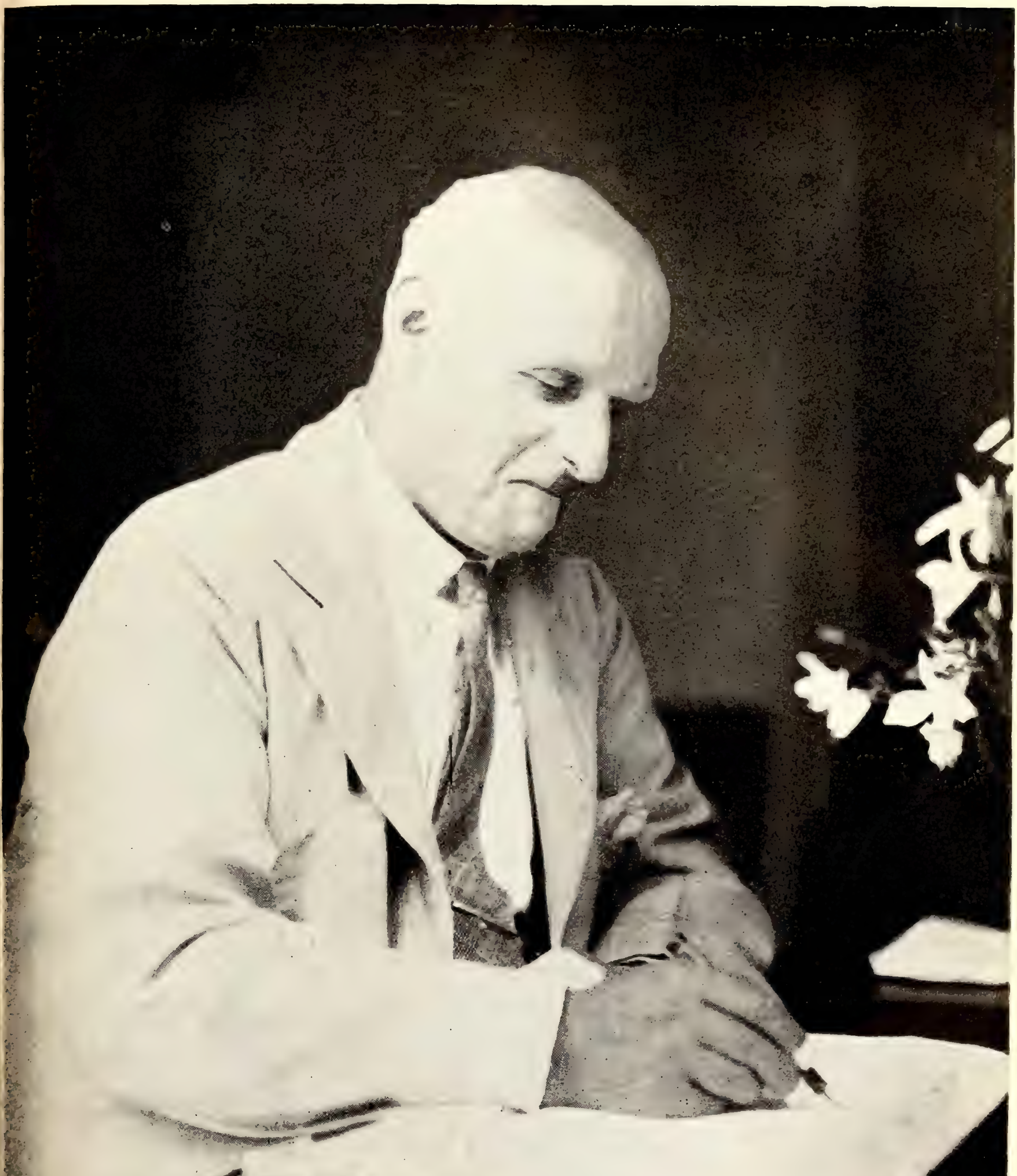
He made very complete collections of birds, butterflies, moths and dragonflies while in Bihar and had many outdoor aviaries where he bred Burmese peafowl and swamp partridges, and where a pair of green wood-quail laid the first known eggs of that bird in one of his aviaries. Besides natural history his other hobbies were gardening and painting.

In 1923 he accepted the job of Curator of the Darjeeling Natural History Museum, which was in a state of decay. He had to reorganise it and start a Society and journal—all very interesting work. His work got great kudos from the museum experts from England who surveyed and reported on Indian museums in 1935-36.

While in Bihar and Darjeeling, he made many collecting trips to the Duars, Darjeeling District, Sikkim and Assam, very often staying with congenial friends. Ornithologically he worked the Duars and Darbhanga District, Bihar, very thoroughly, also the Lepidoptera (butterflies and moths) of the latter district. On one occasion he and Dr. Shaw of Mangpu, collected butterflies in the Chumbi Valley of Tibet, travelling as far as Phari Dzong. On these treks he always carried painting materials to do any interesting bird collected. Many of his bird paintings were reproduced in the *Journal of the Darjeeling* (later *Bengal*) *Natural History Society*. He also filled two huge albums with the heads and breasts of some 659 birds, all painted life-size.

He collected four type specimens of dragonflies (Odonata) and had two birds and one fish named after him.

1. *Megalestes irma* Fraser. Types of both sexes, and others collected near the source of the Rani Khola, near Gangtok, Sikkim,



Charles M. Inglis

on the 29th May 1924. Named, by request, after his hostess, the Hon. Mrs. Bailey of the Residency, Gangtok.

2. *Bayadera longicauda* Fraser. Type, and few others collected at Gangtok, Sikkim, on the 29th May 1924.

3. *Davidius zallorensis delineatus* Fraser. Type, and many others collected at Gangtok, Sikkim, in May (probably 1924).

4. *Anormogomphus heteropterus* Selys. Type of only known female (up to 1934 at any rate) collected at Baghownie, Darbhanga Dt., N. Bihar, on 27th June 1922.

The following birds were named after him:—

1. *Prinia socialis inglisi* Whistler. Collected during various winters in the Duars.

2. *Cryptoplectron manipurensis inglisi* (Ogilvie Grant). Collected with the late A. M. Primrose on the Mornai Tea Estate, Goalpara, Assam.

The following loach was named after him:—

1. *Nemachilus rupicola* var. *inglisi* Hora. (*Records of the Indian Museum*, xxxvii, p. 58, pl. iii, figs. 9 and 10). Streams at foot of the Darjeeling Hills.

He joined the Bombay Natural History Society on the 19th January 1894 and was the second oldest living member, Lt.-Col. R. W. Burton being one year older. The whole of his life since he first came out in January 1889 was spent in India except for nine months study leave in 1929 which was spent in Switzerland and in England. He visited many museums in Europe.

He became a Member of the British Ornithologists Union about 1918 and was elected a British Empire Member in 1930; this membership was later incorporated in that of Corresponding Membership.

He was a Fellow of the Zoological Society of London and was, for a number of years, a Fellow of the Royal Entomological Society of London and a member of the British Ornithologist's Club.

He published the following papers in the *Journal of the Bombay Natural History Society* in addition to over 80 shorter communications on birds and divers natural history subjects:

1. A List of Birds collected during five years' residence in Hylakandy District, Cachar, Vol. x: 453, 609; xi: 77, 199, 474; xii: 286, 676; xiii: 654; xiv: 391.

2. The Birds of Madhubani Sub-division of the Darbhanga District, Tirhut, with Notes on species noticed elsewhere in the District Vol. xiii: 621; xiv: 132, 362, 554, 764; xv: 70.

3. The Fauna of the Darbhanga District, North Bihar, Vol. xix: 136.

To the end he was a regular contributor to the *Journal of Darjeeling (Bengal) Natural History Society*, which he edited for 25 years until his retirement from the Darjeeling Museum.

Mr. Inglis was part author of 'Birds of an Indian Garden', which appeared in the *Agricultural Journal of India* when Bainbrigge Fletcher was Imperial Entomologist. This was later published in book form by Thacker Spink & Co. and ran to two editions, but has been out of print for some years now.

In September 1945 he married Sybil Dorothy Hunt. On retirement he purchased a house and garden in Coonoor on the Nilgiri Hills, South India, an ideal spot for a man of his tastes to retire to. The bird skins and eggs which he brought with him from Darjeeling (only a part of his very large private collection) he housed in the cottage. There was quite a bit of forest near the cottage, the haunt of many birds. Here he and his wife lived very happily, and it was here that the end came, peacefully, in his 84th year.

Simple and unassuming and the best of good companions, he was beloved by all who knew him.

Molliter ossa cubent

PAGE

REVIEWS

1. JUNGLE LORE. By Jim Corbett. Pp. 168, 1954. (Oxford University Press. Rs. 6-8).

The now famous author of 'Man-Eaters of Kumaon' presents his fourth effort, in which he sets out to present 'all I have learnt in a lifetime of Jungle Lore'. In part autobiographical, we get glimpses into the childhood and early years of the author, with him we go through our first-lessons in safety precautions, go out shooting for the first time and share the thrill and delight when he is presented with his first gun and rifle.

The author narrates a number of stories and incidents from his vast experience, and we are shown step by step how a truly great shikari is made. In spite of the author's avowed purpose to present what he has learnt of jungle lore, let not the reader think that all he will need to bring his first tiger to bag is to acquire a rifle and a copy of this book; it is not intended as a text-book on Tiger Hunting.

Some of the descriptions of our glorious jungles and the wildlife therein will bring the old timers nostalgic memories of the good old days. One hopes that the not-so-old timers will realise what they are missing by the continued indiscriminate destruction of game and appreciate the urgent need for the protection and preservation of our fauna and flora.

Although the book makes extremely interesting reading it does not quite live up to the reputation of the author's earlier efforts, nor did it meet your reviewer's expectations.

M.R.S.C.

2. THE SNAKES OF INDIA AND PAKISTAN. By Lieut.-Col. K. G. Gharpurney, I.M.S. Pp. x + 153, 1954. (The Popular Book Depot, Bombay. Rs. 5).

The study of all animals is always helped by the work of enthusiastic amateurs. In India, however, the absence of books which present with the minimum of technical terminology the elementary knowledge necessary to foster this interest, is a serious hindrance to amateur zoologists. In snakes this difficulty has been further accentuated by the mass of superstition and mythological lore which has always surrounded them. After the well-known series of papers by Wall, Col. Gharpurey brought out the first edition of this book in 1935 and this re-print should be useful to all those interested.

The first chapter gives general information about snakes and is followed by one on other animals superficially similar to and likely to be confused with them. Their teeth, poison, glands, scales, classification, identification, the treatment of their bites and protection against them are dealt with separately in as many chapters. The bulk of the book is devoted to the description of the different species of Indian snakes and the 'black sheep' have necessarily been dealt with in greater detail than the harmless ones.

The last three chapters set out briefly various aspects of snake mythology and folklore, their geographical distribution with, finally, some brief notes on the dangerous snakes of the world and their enemies.

The choice of the word 'enemies' in the last chapter is unfortunate, since in nature snakes are killed by other animals only as food, other killings being almost entirely accidental. We do not know what evidence there is to consider the deer as one of the chief enemies of the cobra. The serpent-eagles and other Indian birds of prey which play a really important part in the control of the snake population might perhaps have been mentioned in greater detail.

It is not quite correct to state that in the burrowing amphibians the vent is placed at the end, since these too have a distinct though small tail beyond it. Their other characters are quite sufficient to distinguish them immediately.

It is a pity that the plates depicting snakes which have lain soaked in preservatives for many years, were not re-done. We hope that this aspect will be carefully considered when preparing the next edition. In the absence of any other publication on these common inhabitants of the Indian countryside it is hoped that it will not be long before this occasion arises.

J.C.D.

3. A FIELD GUIDE TO THE BIRDS OF BRITAIN AND EUROPE. By Roger Peterson, Guy Mountfort and P. A. D. Hollom. Pp. xxxiii+318. Size $7\frac{1}{4}'' \times 4\frac{1}{2}''$. 62 plates (mostly in colour), numerous figures in the text, and distribution maps. London (Collins) 1954. 25*s*. net.

Roger Tory Peterson is one of those rare combinations of first class field ornithologist and first class artist who appear on the scene once in a blue moon to make international ornithological history. His famous Field Guides of American birds have, within the last two decades, taken the New World by storm; and this is what the reviewer predicts the present one will do with the Old—at least with the European part of it.

Peterson's system of indicating the salient points for the field identification of species, and for differentiating confusingly similar forms by means of pointers or arrows on his excellently executed sketches, has proved its effectiveness. 'Peterson' is the New World bird-watcher's bible, and its users are reported to number over half a million.

Guy Mountfort supplements the illustrations by concise and admirable descriptions of general habits and other details that go to make up the 'jizz' of a bird, including 'Voice' and 'Habitat', and the excellent little distribution maps for each species by P. A. D. Hollom present a graphic overall picture of the bird's geographical range in Europe and help to round off the excellence and handiness of the volume. Bird lovers in Europe are indeed to be envied on the availability of such a guide, which contains everything that either a beginner or a seasoned ornithologist working unfamiliar ground can wish for. The scope of its usefulness is widened to continental proportions by the fact that editions have been published simultaneously in Dutch, German, French and Swedish and will shortly also be available in Spanish, and later perhaps in Italian and other European languages as well.

As a visiting ornithologist from India who recently had the opportunity of trying out the book in the field in Britain and on the Continent, I have nothing but praise for it. Since a considerable proportion of European birds are winter visitors to India, one can hope to use the Guide with equal success in this country also.

In the course of working with the English edition of the book (partly also with the German), the following points suggested themselves, attention to which in the next edition would, in my opinion very greatly facilitate users' convenience:

1. The absence of scientific names on the pages facing the plates is an unexpected and highly irritating omission, capable of easy remedy.

2. Where the overall distribution of a species extends beyond the bounds of Europe, the map needs to be supplemented by the letterpress. For example 'Map below', could usefully be followed by 'Also Africa, Asia' or whatever it is, so as to give a more complete picture of the birds' entire range.

3. On the distribution map of *Plegadis falcinellus* on p. 28, I notice that Spain lies under a ?. Prof. B. Rensch and myself observed 4 Glossy Ibises in Las Marismas in spring this year, and local reports give the bird as being not uncommon until quite recently, and occasionally met with in small numbers even today.

4. The distribution map on p. 187 shows *Iynx torquilla* as absent in Spain. This is obviously a slip. We saw several examples in southern Spain in March, and the bird did not seem particularly rare in other parts either.

In spite of the 551 species it covers, the Field Guide is truly a pocket book in every sense. Oh for an Indian 'Peterson'!

S.A.

4. POISONOUS PLANTS OF INDIA. By Sir Ram Nath Chopra, Rattan Lall Badhwar and Sudhamoy Ghosh. Vol. 1. Published by the Manager of Publications, Delhi, 1949. (Scientific Monograph No. 17 of the Indian Council of Agricultural Research). Pp. liv+762. Price Rs. 30.

This book was published at the beginning of 1954, in spite of the date on the title page; it had been in the hands of the printers from about 1940. The long interval between the writing and the publishing of the volume is responsible for the main and almost only defect of the work: at the end of each chapter the references given are rather old for a book that aims at helping active workers in their chemical studies on medicinal plants. Thus after the Renunculaceae, the latest reference given is of 1939; most of the others are much older. This is a serious drawback in a work of this kind; it is well known that large numbers of research chemists have been deeply engaged in the study of plant chemistry for many years, but since about 1940 such studies have been intensified in a manner unknown twenty years ago; their published results should have been embodied in this book.

In practically every other respect this book has been of great interest to this reviewer; he has discussed it with many botanists, chemists, etc., and has gathered a very favourable impression from their comments. The price of Rs. 30 seems rather moderate for such a splendid volume.

The introductory chapters are of great interest. In the *List of Illustrations* the authors carefully cite their sources; the authors' aim is to give a good illustration at least for each genus; when such an illustration is found in the botanical literature, they have reproduced it; the line drawings are generally excellent; the photographs are not clear, the reason being that the background has not been carefully chosen. The *Glossary of Botanical Terms* deserves special mention, its conciseness and accuracy.

The Introduction proper discusses the following main points: meteorological conditions over the areas where poisonous plants grow in India; types of vegetation found in the various States or Provinces in the Indian Union; the relations between plant and animal life; a short history of poisonous plants in ancient and modern times. A complete chapter is given to the definition of *Poisonous Plants* and to the study of their toxic constituents; several pages are devoted to the study of poisoning by plants, its diagnosis and treatment, etc. Chapter XI of the Introduction deals with *Economic and Toxicological Aspects*; in this chapter some interesting lists of plants are given, for example Plants producing Dermatitis, Plants Poisonous to Man and Livestock, Insecticidal Plants, Plants Poisonous to Fishes, etc. The last part of the Introduction discusses the distribution of poisonous plants among the various classes of plants, and for the Angiosperms the classification of the families is given in a simplified outline.

The treatment of each family in the body of the book follows a set pattern. Botanical characters; distribution of the family; toxic aspects; constituents, etc. There follows a simple key to the genera in the family. The treatment of each genus may be shown by listing the various headings in e.g. *Aconitum*: name of the genus, etymology of the name when known; botanical characters; distribution in Indian and world geography; toxic aspects; distribution of the alkaloids; pharmacology of aconitines; therapeutic uses; poisoning; symptoms of poisoning in man and in animals; post-mortem appearance; treatment; non-poisonous alkaloids; alkaloids in foreign aconites; Indian aconites.

This fairly detailed introduction is followed by a key to the species of the genus *Aconitum* in India. Each species known to be poisonous is treated shortly but clearly on the same lines as the genus; in addition the local name of the species is listed, whenever there is one. Some of the more important species are illustrated with large and clear line diagrams.

The printing is good and clear, and the use of various distinctive types makes reading very pleasant. The binding does not seem to be very strong; in the review copy which I have been handling for some time, some of the fascicles have already come unstitched.

Taken as a whole the book deserves commendation, and this reviewer feels sure that it will prove of great help to botanists and biochemists and in general to the many readers who are interested in the collection and study of the poisonous plants of India.

H. SANTAPAU, S.J.

5. THE BIRDS OF TRAVANCORE & COCHIN. By Sálim Ali, with 22 plates (16 in colour by D. V. Cowen). Pp. xx+668. (Oxford University Press) Bombay, 1953. Rs. 25.

'The Birds of Travancore & Cochin' is Sálim Ali's fourth and the latest on Indian birds. This work, which is a quasi-technical summarization of his vast experience of the avifauna of the area, is based on the ornithological surveys conducted by him in 1931-1932 and 1947. The results of the earlier survey were published in a series of papers in the *Journal of the Bombay Natural History Society* in 1935, 1936 and 1937. As these papers immediately followed the publication of Stuart Baker's great works, namely, the revised edition of the '*Fauna of British India, Birds*' (1922-1930), and the '*Nidification of Birds of the Indian Empire*' (1932-1935), and because of the new and additional information on birds, their ecology and habits, and the taxonomic reorientation of some of the species, they roused great interest among the ornithologists at that time.

Owing to the curious physiography of Travancore-Cochin causing heavy rainfall and excessive humidity, the fauna is of exceptional interest. The obvious similarity of the fauna of this area with that of the eastern Himalayas and the Indo-Malayan countries, on the one hand, and that of the southwestern Ceylon, on the other, cannot be overlooked even by a casual student of Travancore zoology. There are quite a large number of species of animals (and plants too!) that may be cited as evidence for this phenomenon. They show discontinuous distribution, occurring as they do only in the above-named areas and being cut off from their nearest relatives by vast stretches of country. Sálim Ali's lucid but succinct introduction to the book admirably brings out this theme. The geographic, climatic and geologic factors governing this phenomenon, which are summed up as Hora's Satpura hypothesis, have been summarized with exceptional clarity. The list of the more important birds and four maps illustrating such discontinuous distribution are indeed helpful. An account of the topographic features, climate and forest types of the area concerned marks another item of interest.

The value and importance of field study of birds, which is regrettably neglected in India, cannot be more suitably stressed than by what the author says: 'We have still a great deal to learn about the life-history and ecology of almost all our birds. These are subjects that cannot be studied from dead skins in a museum no matter how large or complete a collection is available. Neither can they get adequate justice from short seasonal field surveys with limited time and opportunities . . . . Only continuous and intensive field-work combined with intelligent experimental and laboratory research on a well thought-out plan are likely to produce the desired results. This implies patient and methodical observation, accurate recording, careful indexing and sifting of the records and intelligent co-ordination of the data.' The reviewer is in full agreement with him, but he may add that, since the same is also true of almost all groups of Indian animals, the responsibility to initiate students in the study of field zoology rests primarily with the teachers of zoology in India.

Another singular feature of the book is the stress laid by the author on the study of economic ornithology—a much neglected item of bird study in India. He goes on to say: '. . . . the purpose of Economic Ornithology is to strike an accurate balance sheet between the harm and the good that different species do by making complete life-history and ecological studies. It is obvious that in a country like ours, so largely dependent upon agriculture and forestry, the role played by birds is of the highest economic consequence.' This is indeed only too true! He has even taken pains to mention some half-a-dozen important problems of economic ornithology, which may be fruitfully pursued by any student without much involvement. May the author's appeal not fall on deaf ears!

Having dealt with the general aspects of ornithological studies in the introduction, the highlights of which have already been mentioned, the author presents in the subsequent portion of the book accounts of all birds known from Travancore-Cochin, numbering about four hundred forms. A short but precise account of each bird has been given under such paras as field characters, status and habitat, distribution outside Travancore, general habits, nesting (season, nest and eggs), besides an approximate idea of the size of the bird and its local name. Such smaller details as the characteristics of allied races have not been overlooked.

What has appealed to the reviewer most in the book is Sálim Ali's vivid accounts of *living* birds. He tells us in plain language how the birds look, what their behaviour in the field is like, and where exactly to look for a particular bird.

Of the nearly 400 forms described, 101 have been depicted in colour. The sixteen coloured plates are a great asset to the book and Mrs. Cowen deserves all our praise for her accurate coloured drawings. Another achievement is the neat and faithful reproduction of colours in all the coloured plates of the volume. A successful co-operation between the artist and the printer is indeed rare these days, not only in India but also abroad. Mrs. Cowen and the *Times of India* Press, Bombay, must, therefore, be congratulated for the production of these fine plates.

Reviewers are generally apt to carp at some faults, however negligible they may be, and the present reviewer takes liberty to do so here. Abbreviated citations of references, such as, 'F.B.I., Birds', 'Fauna', or 'Nidification', given almost throughout the book, have not been introduced anywhere to mean that they belong to Stuart Baker's. Two systems of measure—metric in the text and British in the plates, seem incompatible; a uniform system, whatever one may choose, would have better served the purpose. A few spelling mistakes, such as, *Phragmaticola* (pp. vii, 125 and 433) for *Phragamaticola*, *zeylonicus* (pp. ix, 211, 212 and 432) for *zeylanicus* and *Eudynamis* (pp. ix, 225 and 431) for *Eudynamys*, have caught the reviewer's eye.

Why the author has retained the flycatcher-shrikes (*Hemipus*) and wood-shrikes (*Tephrodornis*) in the family Laniidae (pp. 93-96) is not well understood; both the genera are now rightly claimed to be members of Campephagidae. Further, he does not seem to recognize any subspecies of *Lalage sykesi* (p. 101), though modern ornithology accepts at least two subspecies. Sálim Ali says (p. 171) that *Anthus hodgsoni berezowskii* winters in parts of India. This statement is presumably based on Ripley's [*J. Bombay Nat. Hist. Soc.*, 47: 627 (1948)] record of three specimens of this subspecies from Uttar Pradesh. A re-examination of the same material (Koelz Collection at the American Museum of Natural History, New York) leaves the reviewer beyond any doubt that the specimens are only juvenile *Anthus roseatus*, and that there is no definite evidence so far in favour of *Anthus hodgsoni berezowskii* occurring in India. The author's recognition of only one species of plaintive cuckoos (pp. 219-220) and only one of blossomheaded parakeets (pp. 233-234) seems a little out of date; two species of each are admitted now. Stresemann [*Ibis*, 94: 521 (1952)] has shown that the correct subspecific trivial name of the Brownheaded Storkbilled Kingfisher, referred on p. 249, is *capensis* and not *gurial*. The contentious opinions expressed above do not by any means lessen the usefulness of the book, since no opinion in ornithology, nor for that matter in any other science, is final.

The delight that the reviewer has derived from reading through the book is profound, and it is hoped that it will stimulate and inspire both the amateur and the serious student of zoology alike. Ornithological studies by Indians have been elevated from a rich man's hobby and pastime to the high level of scientific investigation by Sálim Ali, and the reviewer feels confident that some day the book will succeed in fulfilling the author's noble mission 'to popularize ornithology in Travancore not only among the public and pupils in elementary schools, but also as a special subject for zoology students at the University.' Ornithology as a special branch of advanced study in zoology is utterly neglected by almost all the universities in India. The University of Travancore could steal a march over other universities by taking the initiative to recognize the subject. If this branch of zoology is accorded the recognition it deserves by our universities, Sálim Ali's labours will be amply rewarded.

B. BISWAS

The following books have been added to the Society's Library since January 1954:—

Review copies:

1. ANIMAL WONDERLAND. By Frank W. Lane (Country Life Ltd., 1949).
2. HOOFED MAMMALS OF THE WORLD. By Ugo Mochi and T. Donald Charter (Charles Scribner's Sons, New York, 1953).

Purchased:

1. WITH GUN AND ROD. Government of India Publication.

Presented:

1. RECORDS OF PARROTS BRED IN CAPTIVITY. By Arthur A. Prestwich (Arthur A. Prestwich, 1950-52).

2. REPTILES AND AMPHIBIANS. A guide to familiar species. By Herbert S. Zim and Hobart M. Smith (Simon & Schuster, New York, 1953).

3. INSECTS—A guide to familiar American insects. By Herbert S. Zim and Clarence Cottam (Simon & Schuster, New York, 1951).

4. FLOWERS. A guide to familiar American wild flowers. By Herbert S. Zim and Alexander C. Martin (Simon & Schuster, New York, 1950).

5. BIRDS. A guide to familiar American birds. By Herbert S. Zim and Ira N. Gabrielson (Simon & Schuster, New York, 1949).

6. BLIND WHITE FISH IN PERSIA. By Anthony Smith (E. P. Dutton & Co.).

7. MAMMALIAN HYBRIDS. A Checklist with Bibliography. By Annie P. Gray (Commonwealth Agricultural Bureaux, England, 1954).

8. KEEPING LIVESTOCK HEALTHY. Yearbook of Agriculture 1942. United States Department of Agriculture, Washington, 1942.

9. PLANT DISEASES. Yearbook of Agriculture 1953. United States Department of Agriculture, Washington, 1953.

10. CATALOGUE OF FOSSIL CIRRIPEDIA IN DEPARTMENT OF GEOLOGY. Vol. III. By Thomas Henry Withers (The Trustees of the British Museum, 1953).

11. A CHECKLIST OF THE GENERA AND SPECIES OF MALLOPHAGA. By G. H. E. Hopkins and Theresa Clay (The Trustees of the British Museum, 1952).

12. SIMULIIDAE OF THE ETHIOPIAN REGION. By Paul Freeman Botha de Meillon (The Trustees of the British Museum, 1953).

13. CATALOGUE OF METEORITES—With special reference to those represented in the collection of the British Museum (Natural History). 2nd edition. By Max H. Hey (The Trustees of the British Museum, 1953).

14. CATALOGUE OF THE AMERICAN HESPERIIDAE—Indicating the classification and nomenclature adopted in the British Museum. Parts II and III. By Brig. W. H. Evans (The Trustees of the British Museum, 1952 and 1953 respectively).

15. A LIST OF NAMES PROPOSED FOR GENERA AND SUBGENERA OF RECENT MAMMALS FROM THE PUBLICATION OF T. S. PALMER'S 'INDEX GENERUM MAMMALIUM' 1904 TO THE END OF 1951. By L. R. Consibee (The Trustees of the British Museum, 1953).

16. LOWER TERTIARY FORAMINIFERA OF THE QATAR PENINSULA. By Alan Hilder Smout (The Trustees of the British Museum, 1954).

The following books were presented to the Society's Library by the Executors of the Will of the late Mr. M. C. Wadia of Bombay in January 1954.

MAMMALS

1. THE MINDS OF ANIMALS. By Prof. J. Arthur Thomson, 1927.
2. THE ANIMAL BOOK. By Dorothy Childs Hogner and Nils Hogner, 1942.
3. BEASTS OF AN INDIAN VILLAGE. By Douglas Dewar, 1923.
4. BREEDS OF INDIAN CATTLE—BOMBAY PRESIDENCY. By K. Hewlett, 1912.
5. THE NATURAL HISTORY OF SOUTH AFRICA—Mammals, Vol. II. By F. W. Fitzsimons, 1919.
6. THE NATURAL HISTORY OF SOUTH AFRICA—Mammals, Vol. III. By F. W. Fitzsimons, 1920.
7. THE NATURAL HISTORY OF SOUTH AFRICA—Mammals, Vol. IV. By F. W. Fitzsimons, 1920.
8. THE WORLD OF ANIMAL LIFE. By Fred Smith.
9. PLAIN HINTS ON THE DISEASES OF CATTLE IN INDIA. By Veterinary Captain James Mills, 1894.
10. THE ANIMAL KINGDOM. By T. R. Jones.
11. MAMMALIA. By T. Rymer Jones.
12. THIRTEEN YEARS AMONG THE WILD BEASTS OF INDIA. By G. P. Sanderson, 1896.
13. ANIMAL PARASITES AND MESSMATES. By P. J. Van Beneden, 1904.
14. ILLUSTRATIONS OF ZOOLOGY—Invertebrates and Vertebrates. By William Ramsay Smith and J. Stewart Norwell, 1889.
15. THE MENAGERIES (QUADRUPEDS) THE ELEPHANT, Vol. II.

BIRDS

16. BIRDS OF BOMBAY. By H. Edwin Barnes, 1885.
17. DRIVEN DUCK. By R. C. Bolster.
18. THE INDIAN CROW: HIS BOOK. By Douglas Dewar, 1911.
19. INDIAN BIRDS—A key to the common birds of the plains of India, Part I. By Douglas Dewar.
20. INDIAN BIRDS—A key to the common birds of the plains of India, Part I. By Douglas Dewar.
21. INDIAN BIRDS—A key to the common birds of the plains of India, Part I. By Douglas Dewar.
22. AN INTRODUCTION TO THE STUDY OF BIRD BEHAVIOUR. By Eliot Howard, 1929.
23. THE COMMON BIRDS OF BOMBAY. By E.H.A.
24. EGGS AND NESTS OF BRITISH BIRDS. By F. Finn.
25. THE BIRDS OF CALCUTTA. By F. Finn, 1917.
26. HOW TO KNOW THE INDIAN DUCKS. By F. Finn, 1901.
27. HOW TO KNOW THE INDIAN DUCKS. By F. Finn, 1901.
28. HOW TO KNOW THE INDIAN WADERS. By F. Finn, 1906.
29. HOW TO KNOW THE INDIAN WADERS. By F. Finn, 1906.

30. How to know the Indian Waders—second edition. By F. Finn.

31. The Game Birds of India and Asia. By F. Finn, 1911.

32. The Game Birds of India and Asia. By F. Finn, 1911.

33. Hints on the Management of Hawks—Second edition to which is added Practical Falconry chapters—historical and descriptive. By James Edmund Harting, 1898.

34. The Birds of India. Vol. II, Part I. By T. C. Jerdon, 1877.

35. The Birds of India. Vol. II, Part II. By T. C. Jerdon, 1877.

36. The Bird. By Jules Michelet, 1883.

37. Birds of an Indian Village. By Douglas Dewar, 1921.

38. Handlist of the Birds of Egypt. By M. J. Nicoll, 1919.

39. Bird Watching Days. A. W. Robertson and R. D. Powell, 1938.

40. Close-ups of Birds. By H. N. Southern, 1932.

41. Mystery Birds of India. By 'Snilloc', 1945.

42. Poultry Keeping in India. By Isa Tweed, 1909.

43. Birds (London Religious Tract Society).

Fish

44. Handbook of the Freshwater Fishes of India. By Captain R. Bevan, 1877.

45. Fishes, Ascidians, etc. By Harmer Herdman. Bridge Boulenger, 1904.

46. Tropical Fishes. By W. Ladiges, 1934.

47. Fishlore. By A. F. Magri MacMahon, 1946.

48. Silver: 'The Life Story of an Atlantic Salmon'. Second edition. By Roderick L. Haig-Brown, 1946.

Insects

49. Report of the Proceedings of the Second Entomological Meeting held at Pusa on the 5th to 12th February 1917. Edited by T. Paingrigge Fletcher, 1917.

50. History of Insects, The Religious Tract Society, London, 1839.

51. The Formation of Vegetable Mould, through the Action of Worms, with Observations on their Habits. By Charles Darwin, 1904.

52. Vegetable Wasps and Plant Worms. A Popular History of Entomogenous Fungi or Fungi Parasitic upon Insects. By M. C. Cooke, 1892.

53. A Text-Book of Agricultural Entomology—Being a guide to methods of Insect Life and Means of prevention of Insect Ravage. By Eleanor A. Ormerod, 1892.

54. Insect Ways on Summer Days—In garden, forest, field and stream. By Jennett Humphreys.

55. Elementary Text-Book of Entomology. By W. F. Kirby, 1892.

56. BUTTERFLIES OF INDIA, BURMA AND CEYLON, Vol. I. By Major G. F. L. Marshall Lionel De Niceville, 1882.

57. A NATURAL HISTORY OF AQUATIC INSECTS. By Professor L. C. Miall, 1903.

58. BRITISH BUTTERFLIES AND MOTHS. By Percival Westell.

59. ELEANOR ORMEROD, LL.D., ECONOMIC ENTOMOLOGIST—Autobiography and Correspondence. Edited by Robert Wallace, 1904.

60. MOSQUITO OR MAN?—The Conquest of the Tropical World. By Sir Robert W. Boyce, 1909.

61. DEPARTMENTAL NOTES ON INSECTS THAT AFFECT FORESTRY. By E. P. Stebbing, 1903.

62. THE LIFE HISTORY OF THE SPIDER. By J. Henri Fabre.

SHELLS

63. THE CONCHOLOGIST'S NOMENCLATOR—A Catalogue of all the recent species of Shells included under the subkingdom 'Mollusca'. By Agnes Catlow, 1845.

64. BRACHIOPODA OF THE CRETACEOUS ROCKS OF SOUTHERN INDIA—SUBKINGDOM MOLLUSCA.

SNAKES

65. THE POISONOUS TERRESTRIAL SNAKES OF OUR BRITISH INDIAN DOMINIONS (INCLUDING CEYLON) AND HOW TO RECOGNIZE THEM. By Major F. Wall, 1913.

66. SNAKES: Snake-bites and their Treatment. By a Hindu, 1889.

67. CATALOGUE OF SHIELD REPTILES IN THE COLLECTION OF THE BRITISH MUSEUM, Part I—Testudinata (Tortoises) with figures of the skulls of 36 Genera. By John Edward Gray, 1870.

68. CATALOGUE OF SHIELD REPTILES IN THE COLLECTION OF THE BRITISH MUSEUM, Part II—Emydosaurians, Rhynchocephalia and Amphisbaenians, 1872.

BOTANY

69. A CLASS-BOOK OF BOTANY—The elements of botanical science. The Natural Orders. By Alphonse Wood, 1847.

70. THE AMATEUR GARDENER IN THE HILLS—With few hints on keeping Fowls, Pigeons and Rabbits. 2nd edition. By an Amateur, 1894.

71. THE PICTORIAL CATECHISM OF BOTANY. By Anne Pratt, 1842.

72. FARMING FOR PLEASURE AND PROFIT, 6th edition—Roots growing and the cultivation of Hops. By Arthur Roland, 1880.

73. ELEMENTARY LESSONS IN BOTANICAL GEOGRAPHY. By J. G. Barker, 1875.

74. SEED DISPERSAL. By W. J. Beal, 1898.

75. THE ECONOMIC BOTANY OF INDIA. By Bhim Chandra Chatterji, 1910.

76. A LIST OF TREES AND SHRUBS OF THE INDORE STATE. By W. F. Biscoe, 1910.

77. SEED TRAVELLERS—Studies of the method of dispersal of various common seeds. By Clarence Moores Weed, 1898.

78. SEED TRAVELLERS—Studies of the method of dispersal of various common seeds. By Clarence Moores Weed, 1898.

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MISCELLANEOUS NOTES

1. SWIMMING AND LOCOMOTION OF CAPTIVE HEDGEHOGS

To test the swimming powers of a hedgehog a small cement tank, 4′ × 4′ × 1′, was filled with water and one *Paraechinus micropus micropus* Blyth was dropped into it from a height of 3 ft. The animal sank and remained under water for 3 seconds. It then began swimming, keeping its body parallel to the surface of the water. Only the nostrils and tips of the spines were visible. While swimming it kept both pairs of limbs under water. The fully extended limbs moved alternately in a fore and aft motion for the forward propulsion of the animal. It turns by stopping the forearm of the side towards which it desires to take a turn. At the end of the experiment the hinder part of the hedgehog was almost vertical to the water surface.

Every moment the insectivore was trying to come out of the water but was unsuccessful for the wall was too steep to be climbed up. It swam for 5 minutes without showing any sign of fatigue, after which it took a rest of 5 seconds by stopping all movements of its limbs. It began again and during the whole period of 10 minutes it took rest four times, the last time for 9 seconds. A small piece of wood was then thrown in, on to which the hedgehog refused to climb until forced to do so when almost drowning. After coming out of the water it sniffed twice and moved in the corner of the room in which the tank was.

While running the hind limbs provide thrust momentum to the bodies of the hedgehogs (*Hemiechinus auritus collaris* Gray and *Paraechinus micropus micropus* Blyth) while the forelimbs support the heavy front part. The hind limbs occupy a position normal to small running mammals, the feet remaining close together and the soles flat upon the ground when not in motion. During motion the hind feet assume a digitigrade position. Their speed when frightened or when chasing a toad is recorded to be 25 inches per second maximum. Normally they trot at a speed of one foot per second,and can walk for long distances in the night in search of food.

Hedgehogs cannot stand erect on their hind legs like the Indian desert gerbille, *Meriones hurrianae* Jerdon, but they can climb the wire meshes of the cage. One evening I found one hanging under the roof of the wire cage with its front paws, poking its nose through the meshes.

While entering its burrow the hedgehog moves in the normal manner i.e., the anterior portion enters the burrow first. Space inside the tunnel is so restricted that it was thought impossible for a hedgehog to turn round within. But to our surprise the snout came out first. The roof of the tunnel was then replaced by a glass sheet and the sideways turning round of the hedgehog with remarkable swiftness in this very narrow space was observed.

Dept. of Zoology,
Jaswant College,
Jodhpur, ISHWAR PRAKASH
July 12, 1954.

2. EFFECT OF EARTHQUAKE ON ELEPHANTS

Last March, there was quite a severe shock one morning about 6 a.m., when I was camping right inside elephant country on the bank of a river. My own elephant, a tusker, was just approaching me for me to mount, when he started to trumpet. I could then hear wild elephants trumpeting all round, some at a considerable distance, then came the actual 'bump'. Just prior to this, there was a distinct roar as the earthquake was approaching, it was at that period that the wild elephants together with my own were trumpeting.

I had the same experience some ten years ago in the heart of the forest, so it would appear this trumpeting is natural at the time of approach of an earthquake, or anyhow at a time of quite a severe one.

Evergreen Cottage,
Upper Shillong, FRANK NICHOLLS
Shillong, Assam.

3. RORQUAL WHALE NEAR BADAGARA, MALABAR COAST

The carcase of a rorqual whale, *Balaenoptera* sp., was washed ashore near the Government fish curing yard at Badagara on 10th February 1954. It was in a putrid condition without the tail flukes. The body measured 54 ft., the snout being 10½ ft. Each flipper was 10 ft. long. On a search the tail was found at a spot about 3½ miles north of the yard. It measured 8 ft. in length.

A scrutiny of the previous records of stranded whales on the coasts of India since 1748 as listed by Moses (1947) and supplemented by Mathew (1948), Pillai (1949), Gibson-Hill (1950), Chari (1951) and Jones (1953) show that there were only ten instances of stranding of whales along the west coast of Madras State, namely, at Mangalore (1874 & 1891), Madai (1923), Pudiangadi (1924), West Hill (1925), Baliapatnam (1926), Chalai (1927), Vadanapalli (1935), Mulki (1939) and Naduvattam (1947). To these may be added two instances of rorquals washed ashore near Thaikadapuram in April 1949 and near Gangoli in September 1951. The present record brings the total to thirteen.

Marine Biological Station,
West Hill, Malabar, P. I. CHACKO
June 26, 1954. M. J. MATHEW

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4. A LARGE TIGER

You may be interested in the measurements of a large tiger I recently shot in Assam. I could not weigh it but it was quite the heaviest of the 28 tigers I have shot, including a genuine 'ten footer', plus about twice that number whose death I have witnessed. The measurements were as follows:—

Between pegs, nose to end of tail ...	9′-8″	(10′-4″)
Circumference of chest	61″	(54″)
„ „ forearm	24″	(21″)
Length of skull, between uprights ...	15¼″	(16″)
Width „ „ across zygomatic arches ...	11″	(10½″)
Height „ „	7½″	(7¼″)

In parenthesis immediately after these measurements I give those of a big tiger (10′ 4″ between pegs) shot in the Kheri Forests of the United Province on 25th March 1946 by the Hon'ble Iqbal Ahmed, Chief Justice, Allahabad High Court. (Figures taken from a leaflet issued by Messrs. Van Ingen of Mysore.)

One canine which has dropped out of my tiger's skull is 5½″ long and has a circumference of 3½″ at the thickest part.

PACHMARHI, M.P.,
June 15, 1954. T. B. HAWKINS

5. HABITS OF THE ASIATIC BLACK BEAR (*SELENARCTOS THIBETANUS THIBETANUS* G. CUVIER)

In the Fauna of British India—Mammalia Vol. II pp. 211 (1941) R. I. Pocock writes:

'It is largely nocturnal and arboreal, making in large trees rough platforms of branches, known as *wun-thaik* (bear's nest) on which it may sit and rest.'

In May 1925, I trekked from Kyatkon village on the Pegu-Mandalay railway line to Zaungtu on the Pegu River via Wakadok Forest Rest House and Shwelaung Forest Rest House (17°35′N. 96°20′E.), Pegu South Forest Division. I arrived at Shwelaung on the afternoon of the third day. After a short rest and tea, I strolled about in the neighbourhood of the rest house with my tracker Po Hmu of Bawni village. We came upon a bear constructing a nest of green branches in a big tree over a hundred feet up. I brought down the bear with my rifle. Next morning we set out to track either tsaing or bison. On hearing the cracking of branches, we went to investigate and saw a pair of bears constructing a nest also 100-120 ft. high. I shot one with my rifle while my tracker shot the other with my shot-gun as it was coming down the tree. This nest was also under construction and made of green branches of the tree on which it was built.

The monsoon breaks in Burma in May. It appears therefore that bears construct nests for rest and protection during the rainy season.

This species is known as *Wet-wun* in Burmese and *Tsap* in Kachin.

7, Shan Road,
Rangoon, U TUN YIN
January 18, 1954.

6. LONGEVITY OF THE CEYLON RUDDY MONGOOSE (*HERPESTES SMITHI ZEYLANICUS*) IN CAPTIVITY

When visiting some friends recently, I was shown a tame Ruddy Mongoose (*H. smithi zeylanicus*) which had been with the family for many years. It is an old male, now rather fat and losing some of its teeth but apparently still healthy, fairly active and very tame.

Fortunately, its history and approximate age are known. Mrs. Garnier, the owner, informs me that it was obtained in the Ratnapura district (Wet Zone) of South Ceylon in January 1938, when it was believed to be about three months old. Since October 1938, it has been kept continuously by either Mrs. Garnier or her sister, so its age is known to be approximately 16 years and 9 months, at the end of July 1954.

As far as I am aware this is a record age for a mongoose of this species.

Tonacombe,
Namunukula,
Ceylon, W. W. A. PHILLIPS
August 16, 1954.

[Major S. S. Flower (*P.Z.S.* 1931 : 169) in recording the longevity of several species of mongooses, refers to an example of the Indian Stripenecked Mongoose, *Herpestes vitticollis* which lived in the Trivandrum Zoological Garden for 12 years 10 months 18 days. This was the longest age on record, the others ranging chiefly between 4½ and 10 years, except once in the case of an African species—the Yellow Meerkat (*Cynictis pencillata*) which lived in the London Zoo for 12 years, 10 months and 2 days.—Eds.]

7. RECORD SAMBAR FOR THE NILGIRIS

A sambar shot in 1953 by Mr. Atzenwiler within sight of the Ootacamund Golf Club carried the largest recorded head for the Nilgiris. Measurements taken by me personally with a steel tape and checked thrice to ensure accuracy were as follows :—

Length right horn 44½″.
,, left horn 43″
Girth above brow antler both horns 7″.
Widest inside 29⅞″.
Tip to tip 34⅞″.

The largest head previously recorded was 42″ shot some 70 years ago.

KALHATTI, NILGIRIS,
March 3, 1954.

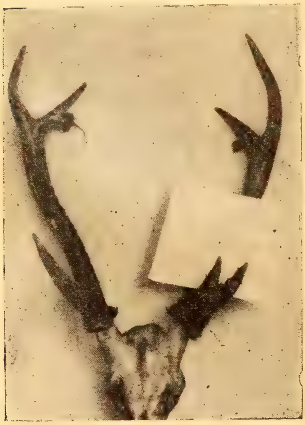
Lt.-Col. E. G. PHYTHIAN-ADAMS
Hon. Supdt. Nilgiri Game Association.

8. MALFORMATION IN ANTLERS OF THE MALAYAN SAMBAR

(*With a photo*)

I recently acquired, as the result of a prosecution under our Game Laws, the antlers of a Malayan Sambar Deer (*Cervus unicolor*).

One of the antlers shows rather a unique malformation of one of the brow tines, which, instead of consisting of one point only, is forked and shows two points.



The antlers measured respectively 23 inches and 22 inches on the outside curve. The 'freak' antler an inch above the burr measured 9½ inches in circumference while the other measured only 7½ inches. The tips of the 'twin tines' measured 7 inches from the burr and were 2½ inches long from inside of the fork.

This is the first time that such an abnormality has come to my notice for, although this freak has obviously been caused by damage to the 'bud' of the growing antler, it is so regular and uniform in growth and appearance that it would appear to be just a normal antler growth.

The antlers were still in velvet which was in the process of being rubbed off. The points were all worn which indicates that there was no pain or discomfort due to the growth of this freak tine.

This stag was caught in one of the wire noose traps known as 'jerat' (Malay) so extensively used throughout the country at the present time. These traps, which are set ostensibly for wild pig, cause enormous damage to the wild life of the country as they are not discriminatory in their action and catch and mutilate animals of all species—from elephant to fawn barking deer, sambar, wild dog and bear.

KLANG, SELANGOR,
MALAYA,
April 8, 1954.

H. J. KITCHENER
Chief Game Warden,
Federation of Malaya.

9. SHIKAR IN INDIA

The following extract from The Asiatic Annual Register of 1800, from 'Chronicle' for May, may be of some interest to several members of the Society as it points out that tiger were alarmingly common 150 years ago, that even at that time 9 ft. 4 ins. was considered an exceptional size for a tiger and, what is most interesting, that camels were used with appreciation in the hunting of tiger under circumstances where elephants are used now-a-days and under conditions, which to say the least must certainly have been exciting.

Extract of a letter from a Cavalry Officer, dated Camp Mooree Jahara, April 21 :—

'. . . . The detachment arrived here on the 11th; and in the evening of that day, a grasscutter of the 1st regiment was seized and devoured by a tigress, eight feet ten inches long.

A party was formed the next morning, who went out to attack her in the place of her retreat; not 400 yards from our lines. In endeavouring to drive her out of her den, two male tigers darted out successively, and were both shot before the female made her appearance, when, after three desperate charges, she also fell, and was cut to pieces with tulwars. The party consisted of the camels of the detachment, and only a few troopers on horseback, whose ardour the officers found it very difficult to restrain; and from the number of shots fired in every direction, it was, upon the whole, a fortunate circumstance, that only one man was wounded by a carbine ball, besides three others whom the tigers sprung upon. The two male tigers did not measure eight feet. We had every reason to expect quiet nights after destroying our dangerous neighbours; but we found that the country abounds with tigers; for the alarm was given three successive nights; but every endeavour to find out the retreat of one of those animals proved abortive.

On the 19th, a man was carried away by a tigress; and from our having missed a dawk (we have reason to suppose it is the dawk hircarrah), the next morning, a party of a few troopers, armed only with pistols, and the camel-riders (troopers) who were only allowed to carry their swords, was ordered out. At sun-rise this morning, at the distance of five miles from camp, in a thick, small jungle on the borders of a nullah overgrown with high grass, the party in search of the tigress started her, when she commenced the attack; the horsemen immediately returned the charge with a volley, which had no other effect than that of making her retreat. The size of this animal was such, that Major Wharton sent a man to camp to bring a reinforcement of a few men armed with carbines; but, before these could arrive, the tigress renewed the attack, and made some furious charges (which the riders avoided by their dexterity in turning their horses), and retreated into the bed of a nullah, where the horses could not follow her. In consequence of this, the pistols were given into the hands of the troopers on camels, who advanced boldly into the nullah. The tigress, grown desperate, was making a most furious spring at one of the troopers, when he, with great steadiness, fired his pistol just as she had sprung, hit her in the head, and brought her to the ground. On measuring her, she was found to be nine feet four inches.

It is unusual to hunt tigers with camels and horses; and although the latter went forward with great boldness, yet they were surpassed by the former, which, I think, from what I have seen, are preferable in this respect to elephants.'

Gudur,
Nellore District, K. M. KIRKPATRICK
September 15, 1954.

10. INTELLIGENCE OF THE INDIAN ELEPHANT

The intelligence displayed by elephants has been described in an article by Mr. Robert Foran which appeared in the *Illustrated Weekly of India* of 28th June, 1953. When the author wrote that article, which he has also illustrated with a number of photographs of the African elephant, he obviously had in mind the animal from Africa and not the Indian. Having been almost continuously associated with the Indian elephant (*Elephas maximus indicus*) for nearly a quarter of a century and also having assisted in the capture and taming of a few hundred elephants in several *khedda* operations held at Kakankote and Budipadaga, names which are famous in this connection in India, I have to state from my experience that the high degree of intelligence claimed for the African elephant by Mr. Foran does not apply, except in a meagre measure, to the Indian elephant, at least not to the animal found in the extensive forests of the Deccan tableland. It is true that a tame Indian elephant can be taught to do some extraordinary feats requiring a high degree of skill—as for example, balancing its huge body on a rolling cylinder, converging its four legs on the top of an inverted wooden tub too small to accommodate them all, picking up a minute object and handing it carefully to the trainer, and so on; or a working elephant deftly directing huge logs of floating timber in between the piers of bridges spanning flooded rivers, to avoid damage to the bridges and piers, etc., but in these instances it is the intelligence of man which comes into play and makes use of the learning capacity of the animal; in other words, man utilises the animal's brawn for producing the desired results.

During each *khedda* drive scores of elephants are driven into the *khedda* enclosure *en masse*, and this is done time after time in the same place and almost under identical conditions. Such captures would have been almost impossible if the Indian elephant had been endowed with the discriminating intelligence ascribed to its African relative by Mr. Foran. I must say that it is the almost complete absence of reasoning power, or to put it in a crude way the stupidity displayed by most of these mighty animals which enables man to impound them almost like sheep in the *khedda* stockade and subsequently noose them with ropes one by one. True, there are rare instances in which an elephant has shown a certain amount of reasoning power which we may term intelligence in the widest sense of the term, but such instances are very few and far between. They are rare exceptions, not the rule.

The roping operation involves the slipping of a loose rope-noose up the trunk of the elephant and on to its neck. For doing this, a scope or so of elephants are first impounded in the roping ring-stockade and they are then roped one by one, in full view of the other animals awaiting their turn to be roped. But, the animals which are looking on all the time their companions are being noosed learn nothing from what they see, nor do they help in freeing their distressed friend who, after the ropes are on him, is forcibly dragged out of the roping ring and bewails his loss of freedom by heart-rending cries and pours forth a constant stream of tears from his tiny, winking eyes. In fact, a captive which is in the act of being roped rarely, if ever, lifts its head or attempts to push down the man who is roping it and who remains perched, often precariously, on the back of a *kumki* elephant. It would have been nearly impossible for the roping squad of *mahouts* to enter the roping ring and carry on their dangerous task had the wild elephants displayed the little intelligence required to use their trunk for pushing down the *mahouts* systematically from the backs of their *kumkies*. This never seems to occur to them; in ninety-nine cases out of a hundred the animals keep their heads bent and submit to the 'machinations' of the humans without any show of their enormous strength or the slightest streak of intelligence. True, they often make clumsy and ineffectual efforts to prevent the noose from being pulled up their long trunks, but this is done more out of animal instinct than from the consciousness that the rope is axing at their freedom.

The fact that in their wild state no two elephants behave exactly alike when they see a hunter shows the meagreness of their reasoning power; one may bolt on seeing the hunter, the next may charge him. The first animal runs away from danger while the second turns to bay; this is a universal reaction common to all animals and not confined only to the elephant.

The elephant recognises its *mahout* by smell, since the animal's winding (smelling) power is better developed than its sense of hearing or sight. This is true not only of the elephant but also of most domesticated animals.

The sense of comradeship is generally well developed in the case of all those animals which associate in herds. A distressed comrade is not normally abandoned to its fate by such animals. For example, on several occasions I have seen a bull bison (gaur) in a herd shot and brought down to the ground, when some of his companions have stood around their fallen comrade and attempted to lift him to his feet. They have had to be scared away by shots.

Animals are generally unable to assess the gravity of personal danger; it is more on account of this than through any sense of personal heroism that they return to free a comrade in distress. It is the human being that assesses the degree of danger to which the animals had been exposed and attributes the sense of heroism to them in his own measure. A sneaking hunter who worms his way through the forest undergrowth is never noticed by an elephant unless he is caught up-wind, when his smell gives him away, or unless he appears in full view of the animal at close range, in which case the animal either runs away from him or charges him outright.

As for the ability of the elephant to fashion steps against obstructing mud banks with the help of their fore feet and tusks, this is more the outcome of accumulated experience resulting from repeated efforts to climb an obstacle rather than from a reasoned-out plan. The accumulated experience of generations of elephants has now probably crystallized into an insect. Its size and strength enable an elephant to cut the steps; for the other smaller animals this would be impossible. It is known, however, that while descending steep paths the elephant always keeps to the beaten track and never diverts from it even if there be an easier one within a stone's throw; this displays absolute want of reasoning power. I know of many an attempted '*river-drive*' at Kakankote (Mysore State) having failed on account of this simple fact, namely, the elephant's refusal to budge from its accustomed route even if there be another in its neighbourhood which is a much easier and shorter one.

Most quadrupeds are excellent swimmers and the elephant can swim too. A new-born elephant, like most other new-born quadrupeds, cannot swim and has to be carried across deep water by the mother.

A full-grown elephant generally avoids falling into game pits not because of its reasoning power or intelligence, but more on account of the fact that it has the habit of constantly feeling with its trunk the ground on which it is about to tread. The trunk of the elephant can be compared to the stick of a blind person. At night, especially, the elephant with its weak power of sight has to depend more on feel and smell. The sense of touch has therefore been well developed. It is the calves that usually drop into the pits, but not infrequently half grown animals, and occasionally even full-grown tuskers too, drop in and are roped. Instances of attempts to rescue a fallen animal are by no means uncommon, but it is mostly the mothers or the foster mothers of the entrapped calves that return to rescue their young ones and even these are often easily scared away by firing a couple of blank shots. The mother returns to the rescue of her young one out of maternal instinct rather than through any feeling of comradeship.

The efficiency of the African elephant in 'road making' or 'dam-construction' has been commended by Mr. Foran, but I must say that their Indian counterparts are mostly untrained engineers; elephant paths frequently go up and down hill ridges, often missing the saddles in the neighbourhood. Quite often they make gradients of 45 degrees which could have been easily avoided by skirting a small neighbouring hillock; but the animals always follow a beaten path,—a path, whether it is good or bad, which has been worn smooth from use, but laid out for them from the accumulated experience and wisdom of generations of their roving forefathers. An elephant hitched to a timber log generally seeks the easiest gradient possible but in this, again, it is guided by the resistance offered by the log and not by the reasoning power of the animal. If, for example, the log is held up by any obstruction along the drag path, the elephant merely uses its brute force to overcome it and often snaps its drag-chain in the effort. It is never known to use its reasoning power for overcoming such obstacles in spite of the fact that it may have done this sort of work all its life.

The construction of dams by African elephants, as described by Mr. Foran, is almost incredible in the case of the South Indian elephant. Wild herds often spoil their only source of drinking water and are forced to leave the locality altogether in quest of water; let alone their ability to construct a water reservoir for themselves by carefully plugging the courses of mountain streams. The description of the sagacity used by the African elephants reminds one of the old Indian fable in which an elephant, which was refused its share of the daily plantain fruit by a tailor, is stated to have gone out to a neighbouring dirty pond, filled its trunk with muddy water, returned and syringed the water on the tailor. The elephant has to breathe and the probosis is the nasal passage; how the elephant retained water in it all the time has not been questioned.

As regards the general health of the South Indian elephant, like its South African counterpart, it too is a healthy animal, though tame elephants sometimes fall an easy prey to the deadly anthrax. Like the African elephants too, they suffer from diarrhoea, and also intestinal worms against which they swallow large quantities of mud which is then ejected along with the worms. A daily bath is indispensable to the South Indian elephant and sometimes two baths are taken, each invariably accompanied by a toilet which consists of sprinkling dry or loose earth or blowing dust all over the body.

The elephant is able to make a quick end of its human victims because of its enormous physical power and large size compared to its victim. Once dashed against the ground or trampled upon the body of man, which is of the size of a mere toy compared to the elephant, is crushed and often reduced to pulp.

There are no two opinions about elephants being strictly vegetarian and even the accidental smell of blood in their diet is often disliked by them.

The Indian elephant does not cover the body of its human victim with leaves etc. and thus give it a burial of some sort as mentioned by Mr. Foran in connection with the African elephant. In every single instance of manslaughter by elephants that I have had occasion to see, the animal had left the body of its victim on the ground and fully exposed to view. It is the habit of the carnivora, on the other hand, to secrete their meat against scavenging hyaenas and vultures by heaping up dry fallen leaves and twigs over it.

I am unable to say anything about the standard of intelligence of the African elephants because I have no knowledge of them in the wild state. But, from the meagre experience I have had with a pair of these animals in the Mysore zoo which used to be tethered sometimes in the forests of my forest division for grazing, and occasionally even for work, I can state that the African elephant, compared to the Indian, is wilder and more difficult to tame or train.

FOREST RESEARCH INSTITUTE,
NEW FOREST, DEHRA DUN,
September 4, 1953.

K. KADAMBI
Conservator of Forests

11. THE ABOMINABLE SNOWMAN

(*With a photo*)

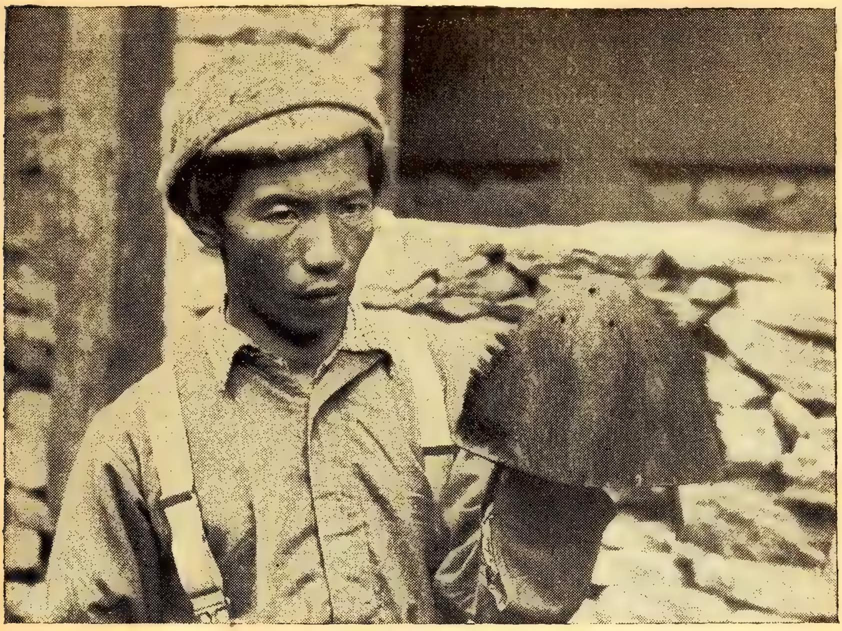
The snowman has again been in the news for some time and it may be of interest to examine the facts and theories which have been put forth in recent years.

We believe that the only instance in which the narrator claims to have personally seen a creature, later reported as a Snowman, and written about it is N. A. Tombazi, F.R.G.S., who in his 'Account of a Photographic Expedition to the Southern Glaciers of Kangchenjunga in the Sikkim Himalaya' writes:—

'I was preparing my instruments and cameras for the start when my attention was attracted by shouts outside the grotto; soon afterwards, the Sirdar and two of the coolies hurried to the tent with the news that a man had been sighted in the valley below. I rushed out—forgetting even to put on one of my snowboots—and gazed searchingly in the direction in which the Sirdar was pointing.

'The intense glare and brightness of the snow prevented me from seeing anything for the first few seconds; but I soon spotted the "object" referred to, about two to three hundred yards away down the valley to the East of our camp. Unquestionably, the figure in outline was exactly like a human being, walking upright and stopping occasionally to uproot or pull at some dwarf rhododendron bushes. It showed up dark against the snow and, as far as I could make out, wore no clothes. Within the next minute or so it had moved into some thick scrub and was lost to view.

'Such a fleeting glimpse, unfortunately, did not allow me to set the telephoto-camera, or even to fix the object carefully with the binoculars; but, a couple of hours later, during the descent, I purposely made a detour so as to pass over the place where the "man" or "beast" had been seen. I examined the foot-prints which were clearly visible on the surface of the snow. They were very similar in shape to those of a man, but only six to seven inches long by four inches wide at the broadest part of the foot. The marks of five distinct toes and of the instep were perfectly clear; but the trace of the heel was indistinct, and the little that could be seen of it appeared to narrow down to a point. I counted fifteen such foot-prints at regular intervals ranging from one-and-a-half to two feet. The prints were undoubtedly of a biped, the order of the spoor having no characteristics whatever of any imaginable quadruped. Dense rhododendron scrub prevented any further investigations as to the direction of the foot-prints, and threatening weather compelled me to resume the march. From enquiries I made a few days later at Yoksun, on my return journey, I gathered that no man had gone in the direction of Jongri since the beginning of the year.



Snowman's Scalp

'When the news reached Darjeeling the press, as usual, headed their comments with captions of "Wild Man", "Snow Man", and the like, seen near Kangchenjunga by an "Italian" traveller. By the time the British and Continental papers had got the news, the length of the foot-prints had been more than doubled; and some ingenious young gentleman on the *Manchester Guardian* had produced a bird-theory out of his own fertile brain.

'When I asked the opinion of the Sirdar and the coolies they naturally trotted out fantastic legends of "Kangchenjunga-demons". Without in the least believing in these delicious fairy-tales myself, notwithstanding the plausible yarns told by the natives, and the references I have come across in many books, I am still at a loss to express any definite opinion on the subject. However, I can only reiterate with a sufficient degree of certainty that the silhouette of the mysterious being was unmistakably identical with the outline of a human figure. I personally rejoice in particularly acute vision and am sufficiently familiar with the appearances of mountain fauna to be able to distinguish a bear, monkey, snow-leopard, ostrich, kiwi (if you like)—and even a man. I am also somewhat versed in the simple analysis of spoor, and can unhesitatingly state that the prints were those of no wild animal common to the Sikkim-Himalaya. It should be borne in mind that the foot of the Tibetan tribes is inclined to be short, flattened-out and wide across the toes.

'I have a theory, which may be worth consideration, if it be not thought too far fetched. Tibet and the contiguous countries are the very citadel of the Buddhist Faith, which in itself is actuated very largely, like the Early Christian Church, by the spirit of asceticism. The country of the Lamas is filled with monasteries; and we must remember that it is only civilisation and increased population that has favoured the cloistral community-system. In Early Church days anchoritism was well recognised and it seems reasonable to suppose that the Buddhist monks may well have turned to this form of mortification, in the same way as the ancient Christian hermits of the Syrian Desert.

'I conjecture, then, that this "wild man" may be either a solitary or else a member of an isolated community of pious Buddhist ascetics, who have renounced the world and sought their God in the utter desolation of some high place, as yet undesecrated by the World. However, perhaps I had better leave the conclusions to ethnological and other experts.'

More recently Eric Shipton the well-known Himalayan climber saw foot prints 12½ in. long in the snow at 12,000 ft. which the authorities at the British Museum apparently held were made by a langur, 'which when bounding puts its hind feet into the marks made by the front feet and lengthens them.' This information however is entirely based on newspaper reports.

A more startling aspect is put forward by Wilfred Noyce who in 'The Ascent of Everest' (*Asian Review*, April, 1954, page 128) writes:

> 'The Lamas of the monastery Thyangboche entertained us to tea, and with stories of that interesting gentleman the *Yeti* or Abominable Snowman. In the winter these creatures are seen near the monastery, playing in the snow. They kill yak, which they skin carefully and plant the horns in the ground. We are all firm believers in their existence.'

In 1952 Messrs. Navnit Parikh, Rusi Gandhy, J. A. Gaitonde and P. V. Pattankar of Bombay visited the Everest area through Nepal. Mr. Parikh reports that some of the Sherpas who accompanied them had actually seen this Snowman or *Yeti*. One of them related how he had locked himself in a hut when he saw one running towards him and that upon his coming out of the hut (after a suitable interval!) he had seen one of his yaks lying dead in a pool of blood. The *Yeti* was described as not more than 5 ft. in height and with reddish-brown hair all over his body and a conical shaped head. A

Lama at the monastery also related how in the winter of 1948 after heavy snowfall he heard the *Yeti* screaming and saw it come down from the slopes of Mt. Kangtega in the east. It did not come very near the monastery, but the Lama saw it walking on all fours and also stand up on its hind legs and scratch its chest with its arms. The Lama confirmed that the *Yeti* was a rather stunted animal with a conical head and with a lot of hair all over the body.

Mr. Parikh's party together with Dr. R. C. Evans of the British Everest Expedition visited the Pangboche Monastery where a junior Lama showed them a 'leather cap' which was said to be the scalp of the *Yeti* and used by the Lamas of the Gompa during important rituals. The accompanying photograph was taken after a lot of persuasion after an offer of Rs. 500/- for the 'scalp' had been refused. Mr. Parikh obtained a hair from the scalp and also brought in the story of a living *Yeti* being kept in the zoo at Shigatse, the second largest town in Tibet and the seat of Panchan Lama.

The latter part of the story was put to Lama Angarika Govinda, (now resident in Devalali), who has some experience of that area, for his comments. In his reply he said that the news of a zoo at Shigatse is more fantastic than the report of the existence of the Snowman. He however added that 10 years ago the *Yeti* was seen in the outskirts of Siliguri when he was at Darjeeling and he heard many interesting details. The creature was seen by the engine driver of a goods train in the evening twilight, just before reaching Siliguri. He described it as a giant-like figure ambling along the railway track. Nobody would probably have taken notice of this report, if it had not happened the same night that a young woman heard somebody knocking at the door of her house. When she opened the door she saw the figure of a giant, whereupon she immediately shut the door with a scream and fainted with fright, thinking that Yama, the God of Death, had appeared before her. Nobody wanted to believe her, but the next morning enormous footprints were found in the soft mud. A friend of Angarika Govinda, a Mongolian Lama, whose name was Geshe Chomphel, happened to be at Siliguri at that time and took exact tracings of the footprints. He showed them to Lama Govinda who remembers that they were 8 inches wide and about 14 or 15 inches long. Their shape was that of a rather clumsy (human) foot, the heel almost as broad as the front-part, the toes very short and indistinct. Lama Govinda adds:

'Lama Chomphel left India long ago, but it is possible that he left the drawing of the footprint in the Allahabad Municipal Museum, where several of his drawings were kept in the ethnological hall of the Museum. Lama Chomphel was an artist as well as a writer of high qualification (he wrote in Tibetan as also in English). I have therefore no doubt in the accuracy of his investigations.'

A letter of enquiry to the Curator, Allahabad Municipal Museum has not yet elicited any reply.

Other reports have attributed a 'peculiar whistling note' to this creature.

The hair from the scalp of the 'Snowman' procured by Mr. Parikh was examined by Dr. Leon August Hausman, M.A., Ph.D., Department of Zoology, New Jersey College for Women, U.S.A., who is an authority on hairs of all kinds. In his initial report he said that under the microscope the structural elements of the hairshaft agreed with those of an *Ursus* or of an anthropoid of some sort (not *Homo*). He compared it with hair from the dorsum and head of Langurs (*Presbytis* or *Semnopithecus*), Brown Bear (*Ursus arctos*) and the Takin (*Budorcas taxicolor*) and could not match it with any of them. After seeing the photograph he said that the so-called 'scalp' could well be the moulded and sewed artifact from some mammal, which may have been brought in by a traveller and may not belong to a Tibetan species at all. The identification of the hair therefore appears impossible, though it may be worth recording that in an earlier letter Dr. Hausman had said: 'Its cuticle is uniformly stained—this is an artificial feature, not a natural one—as mammalian hairs are not colored in this way (except by skin gland secretions—and this is none of these). The coloration, thus produced, reminds me of the color and mode of coloring of hairs I have examined from early Egyptian and Peruvian sepulchres'.

The story of this hair was perhaps responsible for the recent '*Daily Mail*' Expedition in search of this strange creature. The party failed to find the Snowman, and we have now to wait for something more definite to turn up.

EDITORS

12. THE OCCURRENCE OF THE CRESTED BUNTING (*MELOPHUS LATHAMI*) IN SAURASHTRA

While in the Gir Forest with M. K. Dharmakumarsinhji we saw a single female Crested Bunting on the Hiran River at Sasan on 7-4-54. I believe this is the first record of the bird from Saurashtra. Information regarding its movements in the plains of Gujerat is needed.

Jasdan,
April 23, 1954.

Y. S. SHIVRAJKUMAR

13. AN INTELLIGENT MYNA

On July 14th at 2.30 p.m., I threw a piece of stale bread on the terrace of our neighbour's house from our window and was watching whether any bird would come and take it. There was a pair of Common Mynas nearby. One of them picked it up in its beak and was about to fly off when the other raised the harsh call generally uttered as alarm. I saw 5 or 6 House Crows coming swooping down. The myna with the crumb of bread in its beak hopped to the nearest bamboo pole (one of the many stored on the terrace) and tucked it inside the hollow end and perched above on the bamboo. After the crows had flown away the myna jumped down, carefully surveyed in all directions, put its beak inside the hole and took out the bread. Then the pair shared the hearty meal.

c/o Dr. M. V. N. Murthy,
Geological Survey of India,
Calcutta-13,
July 22, 1954.

Mrs. SYAMALA MURTHY

14. BAYAS AND FIREFLIES

I was interested to read in the *Journal* of December 1953, the letter 'Bayas and Fireflies' by Mr. R. M. Aldworth.

I was hitherto under the impression that the story of weaver birds using fireflies to illuminate their nests was a purely local one for this part of the country, but it seems that it is a fairly widespread one. It was not long after I arrived here that an Estate writer told me the story. I was sceptical from the start, and it was some time before I was able to get to the bottom of the mystery for myself. On several occasions I have inspected nests and in most cases have found insects roughly pushed head first into the mud or clay at the side of the nest chamber. I have never seen a live insect imprisoned and not all were fireflies by any means. I have come to the conclusion that the insects are placed there for no other reason than as a store of food against hard times; this, I think, is the only logical reason for such a habit.

KUMBAZHA ESTATE,
PATHANAMTHITTA P.O., & T.O.,
TRAVANCORE, S. INDIA, P. G. S. HALL
April 18, 1954.

[It would appear from the above that Mr. Hall has *commonly* found insects stuck in the mud within Baya nests. Most observers have recorded this as a very exceptional occurrence only, and probably accidental. However, the explanation is unconvincing. It is difficult to believe that the quantity 'stored' can be sufficient for a meal, or that a Baya would ever be so hard put to it for food to fall back on desiccated remains of insects!—EDS.]

15. MORE NOTES ON FINN'S BAYA (*PLOCEUS MEGARHYNCHUS*)

After the recent publication of my note on Finn's Baya *Ploceus megarhynchus* (*JBNHS,* 51 : 200-204) I had occasion to visit the bird market in Calcutta, where I found a large Baya, apparently of this species, being sold in some numbers. I bought a few birds in the hope of being able to study their plumages, but they did not survive very long. The five additional skins now available in Bombay, however, if compared with the specimens listed earlier produce interesting results :

Four of the 11 birds dealt with in my previous paper, viz., Nos. 6, 7, 8 & 9, were cage birds and not procured directly from their natural habitat. If these four, together with the fresh specimens from the Calcutta market are compared with the others (excluding those in complete non-breeding plumage) they fall into two distinct groups:—

Group I. The 'cage' birds, have:

(*a*) yellow on the rump and upper tail coverts;

(*b*) the yellow on the underparts extending to and including the vent and under tail coverts;

(*c*) traces of a broad, brown pectoral collar often broken in the centre, leaving dark patches on both sides of the neck.

The vent of specimen No. 6 obtained from the Victoria Gardens was, upon re-examination, found to be pale yellow and *not* white as originally recorded.

In addition to the above, Finn's description of *rutledgii* (*Ibis*, 1901, pp. 29-32) which is accompanied by a coloured plate also shows all the three characters mentioned above.

One ♀ (sexed *post mortem*) from among the fresh specimens was sketched in color in April when no collar or yellow was visible. When it died on 8th October the underparts had become pale yellow and distinct traces of a collar were discernible.

Group II. The wild birds obtained by O'Donel in the Bhutan Duars, and again recently by Dr. W. Koelz at Agia near Goalpara in Assam, differ from Group I in the following:

(*a*) No (or very slight) traces of yellow on the rump;

(*b*) a *white* vent occasionally extending from the lower belly up the breast in the form of a tongue;

(*c*) little or no traces of the brown pectoral band.

Dr. Koelz has been good enough to examine several other specimens in his collection (also from Agia), and confirms the above characteristics.

The measurements of the two groups are similar, but there can be little doubt that they represent separate populations.

P. megarhynchus was described by Hume from Kaladungi below Naini Tal, on the strength of two birds in non-breeding plumage, and we must determine to which of the above groups they belonged. The specimen in the Indian Museum, presumably the type of Finn's *rutledgii*, bears on the label 'Purchased from W. Rutledge whose suppliers obtained them from Naini Tal area'. Harper in *Ibis*, 1902, page 169, and *Bull. B.O.C.*, 1903, page 23-24, refers to specimens obtained from the Calcutta market and said to have been brought from Gorakhpur, 300 miles south-east of Naini Tal. Current enquiries in the Calcutta market in regard to the specimens now purchased by me also indicated the same area of origin, and it would therefore appear that the form represented by the cage birds (Group I) is from an area in the foothills of the Western Himalayas adjacent to where the type of *megarhynchus* was obtained by Hume. That *rutledgii* is a synonym of *megarhynchus* was later admitted by Finn himself.

The 'wild' population of the Bhutan Duars (Group II) extending east at least to Agia near Goalpara in Assam thus differs from true *megarhynchus* and remains unnamed. The provenance of the caged birds is, however, to some extent speculative and it is therefore advisable to await the collection of specimens of this form in their natural habitat and in breeding plumage before finally naming an eastern race, as seems called for.

The voice and notes of the cage birds were a loud *chit-chit* quite different from that of the Common Baya. The iris was noted as bright orange in a ♂ in bright yellow plumage, and umber-brown in a female.

75, ABDUL REHMAN STREET,
BOMBAY,
August 15, 1954.

HUMAYUN ABDULALI

16. SPARROWS NESTING IN COLONIES IN TREES

In May 1949, in the Gandhi Gardens at Karachi, I noticed a number of House Sparrows (*Passer domesticus*) nesting in a colony. The dry leaves of a palm had not been cut for some time, and drooping against the stem formed a large pad about 20 ft. up, under the growing leaves. I saw a sparrow fly with a piece of nesting material into this mass of dry leaves and enter it by a small hole, like a tunnel in an earthbank. Further observation revealed that at least 5 pairs had similar holes in different parts of the mass of leaves round the stem. I have not seen reference to sparrow colonies in trees in India though Zarudny (*JBNHS* **28**, p. 230) records 29 nests of the Mesopotamian race *biblicus* in a small bush.

FAIZ & CO.,
75, ABDUL REHMAN STREET,
BOMBAY 3,
January 22, 1954.

HUMAYUN ABDULALI

[Bates and Lowther 'Breeding Birds of Kashmir' (p. 169) say that in Kashmir many House Sparrows are found in well wooded country and on forest fringes breeding more or less in colonies in natural hollows in trees.—EDS.]

17. A DISPLAY OF THE REDWINGED BUSH-LARK (*MIRAFRA ERYTHROPTERA* BLYTH)

During the hot summer months, the best time to observe birds is in the early mornings, at which time the various species are most vigorous. On the morning of June 14th, I was slowly walking through scrubby thorn jungle growing over a waste land much fissured by numerous small dry streamlet beds, when my attention was attracted by what I first took to be a pair of quail fighting. On drawing closer, however, I found that the birds were Redwinged Bush-Larks and, so engrossed were they in the display I detail below that I was able to come to within two yards of them without their taking any notice of me whatsoever.

The birds, when first observed, were crouching, facing each other, with wings held low and feathers ruffled, for all the world like a pair of miniature fighting-cocks, at a distance of about 6 inches from each other. Holding this pose for a few seconds, one would suddenly make a rapid dart at its opponent, who would just as rapidly move backwards so that no actual contact between the two was made.

The two would then pause or move slowly around, their bills pointed towards each other all the time, there would be a sudden rush again by one or the other and so the performance was repeated over a considerable period of time—about ten minutes. Some of these lightning rushes and retreats were up to over 6 ft. of distance and I marvelled at the retreating bird's dexterity at running backwards so smoothly for at no time did any one of the two take flight or leave the ground, neither did they leap forwards or backwards but ran with small, quick steps. As I have said before, although the appearance of both birds denoted pugnacity, there was never any actual contact between them.

The interesting display was unfortunately disturbed by my dog, which returned from chasing hare. On its arrival, the larks took flight and disappeared. I do not know whether this display was an act of courtship between a breeding pair, or whether it was an actual fight between two rivals, either for a breeding site (the species was breeding at the time) or because one had infringed on the territory of the other and was being driven off.

Gudur (Nellore). K. M. KIRKPATRICK

[The actions described doubtless represent formalised fighting between rivals, presumably males and presumably for territory. These formalised innocuous encounters are to be seen in many bird species. In so far as they do not result in serious injury to the combatants they serve a useful purpose in the survival of the species.—Eds.]

18. THE COURTSHIP DISPLAY OF THE LARGE PIED WAGTAIL (*MOTACILLA MADERASPATENSIS* GMELIN)

Whilst inspecting Mica in a factory on the outskirts of Gudur this morning, my attention was attracted by the loud song of a Pied Wagtail. On investigation, a pair of these birds were observed perched on the edge of the flat roof of an office adjoining the factory sheds. The female was perched, half-crouched with breast feathers slightly fluffed out and wings partly open whilst the male, some twelve inches away from her, was singing loudly, his throat feathers distended, his breast, abdominal and rump feathers fluffed out and his tail cocked high over his back with his wings extended stiffly away from his body. As he sang, he approached the female with a stiff, mincing step, sometimes stopping to turn around in a little dance, until he was almost bumping into her—this display lasting some two minutes. When he was close to her, she crouched down on the roof-edge and submitted to him. He treaded her for five to ten seconds and again jumped from off her back, to commence his display but moving away from her this time until he was some twenty inches distant from her—she not having moved her position at all during this performance—when he suddenly sprang upwards, mounting some five feet into the air above the roof with a single rapid wing-beat. From this altitude, he slowly sank back to the roof on stiffly outspread wings, the first primaries being held well forward and the entire wing being spread to the full, the abdominal and rump feathers fluffed out entirely like a puff-ball and the tail thrown well up over the back, the feathers slightly spread, his legs hanging stiffly below him as he sank back to his perch, singing loudly all the while. As soon as he touched down he again sidled up to his mate with his stiff, mincing gait. She submitted to him once again and immediately after copulation both birds suddenly took flight and disappeared from view over the factory roofs.

GUDUR P.O.,
NELLORE DISTRICT, K. M. KIRKPATRICK
August 10, 1954.

19. THE OCCURRENCE OF FRANKLIN'S NIGHTJAR (*CAPRIMULGUS MONTICOLUS MONTICOLUS*) IN TRAVANCORE-COCHIN

Franklin's Nightjar has hitherto not been recorded as occurring in Travancore, and in Sálim Ali's recent book 'The Birds of Travancore and Cochin' it merely gets an 'honourable mention'.

In February 1954 in order to definitely establish its identity I sent a specimen skin of a bird which I believed to be of this species to the Society and it was identified as a female. By a strange coincidence a day or two after I had received this information I picked up another bird of this species in an exhausted condition. This bird, a female, revived sufficiently to fly away after I had poured a few drops of water down its throat.

Franklin's Nightjar appears to be not uncommon in the Peermade Hills of Travancore during the dry weather months (November to April) for its distinctive call *choee* can frequently be heard near localities where there are expanses of slab rock surrounded by thin jungle and grassland. I have often seen and heard the male, identified by its white wing patches, uttering this call from the ground or perched in a tree or when in flight, but I have never heard the female do so.

I do not think that this nightjar remains in the area during the monsoon months, but further observation is necessary before this fact can be established.

NELLIKAI ESTATE,
VANDIPERIYAR P.O.,
T.-C. STATE, M. C. A. JACKSON
S. INDIA,
May 2, 1954.

20. OCCURRENCE OF SPURS IN THE FEMALE JUNGLEFOWL (*GALLUS SONNERATI*)

In March 1949, Mr. R. F. Stoney sent in the skin of a female Junglefowl (*Gallus sonnerati*) shot at the foot of the Segur Ghat in the Nilgiris which is in normal plumage but has 1 inch spurs on each leg. Col. Phythian-Adams who was with Mr. Stoney sexed the bird by dissection.

Stuart Baker in 'Game Birds of India', Vol. III, p. 132, says of the female of the Red Junglefowl: 'undeveloped spurs are occasionally present. Tickell obtained such a specimen in Singhbhum, and I have myself shot half a dozen females showing spurs, which in one instance exceeded half an inch in length'.

There does not, however, appear to be any record of this having been observed earlier in the Grey Junglefowl.

EDITORS

21. THE GREAT INDIAN BUSTARD

In the *Journal* Vol. 51, page 276, Mr. F. H. B. Tyabji recorded having seen several hundred bustard together at one time. Subsequent correspondents expressed surprise at these observations as no one ever appeared to have recorded having seen the Great Indian Bustard in such large flocks. It is therefore interesting to quote from 'Records of Sport and Military Life in Western India' by the late Lieut-Colonel T. G. Fraser (1881), page 138:—

'On our arrival at the little ghat, across from M—m [Malegaum?] and descending to the plain, I drew B—d's attention to a fine bustard near the roadside, and two or three more further on. Getting our shot guns, we made towards them, but these wary gentlemen were not to be done so easily, and the manoeuvre of ringing could not be effected. As we approached they rose, and though too distant for effect, we both fired, and the moment we did so, in an instant from every direction around us rose flocks of bustard, till some eighty or a hundred were on wing at once. We were saved the humiliation and disgrace of seeing them fly unharmed away by a couple of them passing over us, one of which we brought down. Whether a flight of locusts or grasshoppers had alighted to attract this extraordinary flight of birds, or whether they assembled for migratory purposes, I cannot say, but never before or since have I witnessed such a sight.'

The period referred to is in the 1840's.

EDITORS

Col. R. W. Burton offers the following comment on above:—

'In view of the greater abundance of all species of game birds in India a century ago it is not very surprising that there is record of the Great Indian Bustard having been seen on one occasion in the Bombay Presidency in the 1840's in a large flock of 80 to 100 birds. That the occurrence was even then most unusual is known by the statement by Colonel Fraser in his book, ". . . never before or since have I witnessed such a sight".

What is most surprising is that in these days of the Bustard in India having become a vanishing species it should be reported that during the years 1923-1926 flocks of 200 to 400 bustard were seen along the Nizam's State Railway in the Manmad direction.

What can be the explanation? One large assembly recorded over a hundred years ago, and nothing of the kind until eighty years later when, despite the species having become increasingly scarce, two much larger flocks are seen.'

[A possible explanation of the later records was suggested by K. S. Dharmakumarsinhji's note published on p. 740 of Vol. 51.—EDS.]

22. OCCURRENCE OF THE BLACKNECKED CRANE (*GRUS NIGRICOLLIS*) IN INDIAN LIMITS

While serving as Political Officer of the Subansiri Area of the NE. Frontier in 1946-48 I discovered that a flock of this species regularly winters in the Apa Tani Valley.

The Apa Tani Valley which lies in the heart of the Dafla Hills, 60 miles north of N. Lakhimpur in Assam, is a geographical freak and the tribe that inhabits it is even more remarkable. After a six days march over a tangle of mountain ranges, intersected by precipitous ravines and gorges, and covered from base to summit in dense evergreen forest—except where this has been cleared by the scattered and primitive Dafla settlements for their slash-and-burn *jhum* cultivations—one climbs a final ridge and looks down on a flat, open basin, a Manipur vale in miniature, only at an elevation of 5,000 ft. Like the latter it is obviously the dried-up bed of an old lake, and is inhabited by some 20,000 Apa Tani tribesmen who have evolved an entirely self-sufficient and highly intensive agricultural system which is quite unique. Not an inch of the valley floor is wasted. The irrigable portions are under a complicated series of rice terraces fed by the Kale river which has been canalised and diverted to water the greater part of the arable area. The *bunds* bounding the terraces and any dry and non-irrigable land are sown with millet, and the slopes and the surroundings of the seven large villages are planted with carefully tended groves of *Pinus excelsa* and a species of bamboo. These are grown for building purposes and neither are endemic in the neighbouring hills but were brought by the Apa Tanis on their original migration from some sub-Himalayan source.

The Blacknecked Cranes are a well-known and conspicuous feature of the avifauna. According to the tribesmen a flock varying 20 to 40 have visited the valley every winter within human memory.

The first year I was there they arrived in mid-November. There were 27, and they appeared quite suddenly one night. Their habits were very regular. During the day they fed out in the open fallow fields on fallen grain, usually in one flock but sometimes broken up into two or three parties. They took little notice of the Apa Tanis working in the fields who did not molest them, but were very suspicious of anyone not in tribal dress, and it was impossible to get within gunshot. In the evenings they flighted to one of the patches of swampy land which lay on the outskirts of the valley and spent the night there. They seldom took wing unless disturbed or when changing ground, and when they did so would fly low with alternate flapping and long glides. They never left the confines of the valley. After much stalking I shot a male and confirmed the identity. At the end of February, they began to get restless. The flock would be feeding quietly, when suddenly they would all burst into a chorus of trumpeting, and first one and then another would start to prance and caper. At last in the first week of March, I disturbed them one morning while preening and basking in the warm sun. This time instead of flying off as usual to some other ground, they set their wings and began to soar upwards in circles until they were high above the level of the hills surrounding the valley. Then, still on motionless wings, they swung into formation in a clear-cut chevron and headed north. When they reached the head of the valley they hesitated and then broke up and came slanting back to the rice fields. Next day, however, they were gone.

They returned the next autumn. This time the flock was smaller and there was a smaller crane of a different species with them—I think, a Demoiselle.

It is rather surprising that having come so far, the Blacknecked Cranes never continue to the rich feeding grounds of the Assam Valley as do the Barheaded Geese and Ruddy Shelduck who breed in the same area. The latter two species regularly passed through the Apa Tani Valley on their spring migration and would often linger for several days, but appeared to take a different line in the autumn, or else went over by night without stopping as we never saw them then.

Hunnersley, Burley,
Ringwood, Hants, U.K.,
February 20, 1954.

F. N. BETTS

23. THE STATUS OF THE PHEASANT-TAILED JAÇANA (*HYDROPHASIANUS CHIRURGUS*) IN SOUTH INDIA

The two notes in the *Journal*, Volume 50, pages 406-407 and 947-948 and the more detailed note in Volume 51, pages 741-742, have prompted me to place on record additional information regarding this Jaçana in the Madras State, as it is incorrect to regard it as uncommon in South India.

My observations and records show that it is quite common in the Madras State, at least so far as the Southern Districts are concerned, and the information furnished in the note in Volume 51 establishes the fact that it is also common in the Andhra portion of what used to be the Madras State.

During many years' residence in South India I have seen them at frequent intervals in small numbers in Villupuram, Tanjore, Trichinopoly, Madura and Tinnevelly Districts. It also occurs in North and South Malabar and in South Kanara and Travancore State where it may be considered as much more common, especially during and immediately after the South-west Monsoon. Most of the birds on the Malabar Coast are seen in pairs when the monsoon has set in and by late September, October and November they have invariably formed small parties.

A nest with four fresh eggs was taken by me in South Kanara (3-9-1943) in a tank in a large expanse of paddy fields, within a 100 yards of the railway track. The nest, which was floating, was constructed amongst water lilies, reeds and grass, the depth of the water being between 3 and 4 ft. The eggs from this nest have been given to the British Museum, Natural History, South Kensington, London.

A friend of mine shot a female Pheasant-tailed Jaçana at Alwaye, in Travancore State, during the South-west Monsoon and obtained a fully formed oviduct egg from the bird.

The above records appear to establish that the breeding season is during the South-west Monsoon on the Malabar Coast.

LONDON,
January 3, 1954. C. H. BIDDULPH

24. OCCURRENCE OF BRONZECAPPED OR FALCATED TEAL (*EUNETTA FALCATA*) NEAR CALCUTTA

On the 24th January this year I was out duck shooting with Mr. F. A. Ainslie at the Salt Lakes within 25 miles of Calcutta. I was about to fire at a flight of duck when I noticed a pair flying at a lower level and got both with a right and left. I recognised the male as a Bronzecapped Teal immediately, and the female seemed to be of the same species. On returning home a reference to Stuart Baker and to the Fauna confirmed the fact that I had obtained a pair of Bronzecapped Teal.

I presented the two specimens to the zoological galleries, Indian Museum, Calcutta, and the Curator Shri M. N. Datta writes confirming that they are the Bronzecapped Teal representing both sexes and in full plumage. They are now on view in the Museum, and the drake with fully developed sickle-shaped secondaries is a most handsome bird.

All my books of reference state that the occurrence of these teal in India is very rare, and during all the years I have been shooting I have not heard of a specimen being recorded in India.

4/2 MIDDLETON STREET,
CALCUTTA, J. N. TAYLOR
April 14, 1954.

[This duck has also been obtained in Samastipur District in Bengal, Patna (Bihar), Jhelum (Punjab), Roorkee (U.P.) and as far west as Sind and Kutch. Higgins in Assam saw 82 shot on 53 occasions between 1908-43. Attention has been drawn to the differences between this species and the gadwal in *JBNHS*, vol. 48: pp. 366-367.—EDS.]

25. BIRDS ASSOCIATING NATURAL PHENOMENA WITH FOOD SUPPLY

In the *Ibis*, vol. 95 (1953) p. 142, Mr. W. W. A. Phillips published an interesting note entitled 'A Grass-fire Association of the Ceylon Swallow *Hirundo daurica hyperythra*' which calls to mind numerous instances of birds taking 'advantage' of grass or forest fires, and other natural phenomena. Not considering such commonplace behaviour of sufficient interest, I did not commit my observations to paper. However, my observations are not restricted to 'fires' alone, but extend to the association of birds with the migrations of certain species of ants.

Birds soon learn to appreciate the advantages to be gained from natural occurrences, particularly where resulting in an increase in their food supply. Thus it is quite simple to see how the sign of smoke spells food in the 'mind' of some insectivorous birds. The behaviour of the birds present in the area at the time is a signal for others to join in the hunt. On many occasions I have witnessed birds 'going to a fire' and feeding on the insect and other life escaping from the smoke and flames. The birds did not only feed on the escaping fauna, but they also fed on the singed and partly roasted corpses left in the wake of the fire.

When in the Nepal Tarai in 1932, grass fires were frequent and on each occasion I observed large numbers of swallows, drongos (*Dicrurus*) and shrikes (*Lanius*) attracted to them. The birds frequently swooped down through smoke, and, not infrequently, were dangerously near to the flames. Birds ranged from 'fire level' upwards catching insects in the smoke. Some of the drongos would take up their positions on reeds in advance of the flames and make short sorties from their points of vantage, while others fed on the singed and partly roasted insects among the smouldering embers. Birds seem to come to the fire from all directions.[1]

The congregations of birds at the marriage flights of ants and termites are too well-known and so need not be referred to here. Flights of locusts, however, are usually a sign for most birds to seek shelter, but some birds will feed on the fringes of the flights, and after the swarms have passed feed on the corpses left in the wake of the flights. Swarming bees are pursued by bee-eaters (*Merops*), the birds snatching a meal on the periphery of the swarm.

Migrant ants may be divided into two groups, the diurnal and nocturnal migrants. Of the two the former are of interest for purposes of this note. Although the ants are not preyed upon to any great extent, the fauna they disturb in the course of their migration is eagerly collected by birds and other animals.

On several occasions I have observed swarms of *Dorylus* sp. migrating in 'full formation' over the beds of dried ponds. The ants covered a very considerable portion of the beds. They went systematically through every crack and crevice of the drying clay driving everything before them, winged or otherwise—insects of all kinds, arachnids, myriapods, and even some small skinks and geckos—all hurried before the 'red-brown menace'. Several drongos, shrikes, and other insectivorous birds took advantage of the situation and swooped down on the fauna in flight, but did not attack the ants. Among the birds there was often an odd kingfisher (*Halcyon smyrnensis*) taking toll of the lizards and mole-crickets (*Gryllotalpa*) as they hurried to safety.

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[1] A specimen of the Shikra hawk, collected by the Mysore Ornithological Survey had all the primaries and some secondaries of one wing, and also the tail tip, considerably singed, no doubt accidentally while hunting in such a fired grass-and-scrub patch (*JBNHS*, 44 (1): 237.—EDS.

On other occasions I have witnessed the mass migration of a large black, highly polished, stinging ant (I cannot recall the name). This species migrates in enormous swarms, sometimes several yards wide and long. Such swarms appear like moving carpets of black! Like *Dorylus* they drive everything before them. They get into every crevice and under every stone and dislodge every form of life that might be there, or fall upon the victims and devour them on the spot. On one occasion I saw a 5 to 6 ft. Rat Snake (*Ptyas mucosus*) dislodged by them from under a rock. The snake went for its life. In all cases I saw birds feeding on the wing and on the ground, but clear of the ants. No birds appeared to tackle the ants.

Such associations between birds and migrating ants are not uncommon. The sight of the abundance of insect life on such occasions and the behaviour of birds in the immediate vicinity of the swarm no doubt attracts more and more birds to the feast.

DOMINION MUSEUM,
WELLINGTON,
NEW ZEALAND,
May 11, 1953.

CHARLES McCANN, F.L.S.

26. SOME BIRD NOTES FROM CHINGLEPUT DISTRICT, MADRAS

1. On the night of 31st March I had an interesting visitor whose name, I think, should be recorded. This was a Bluethroated Flycatcher (*Cyornis rubeculoides*).

It turned up on the upstairs verandah where I was sitting, perhaps attracted by the light, and blundered about there, as birds on passage so often do. The blue and rusty colouring showed it to be something quite unusual. When startled, and occasionally while at rest it emitted very sharp and powerful 'cheeps' more tuneful than those of the Brown Flycatcher.

With some difficulty I was able to capture it from its perch on one of the rafters, and then had full opportunity to study it, though it proved a most unwilling captive. It was quite clearly a male Bluethroated Flycatcher and with Baker & Inglis in one hand and the bird in the other I was able to compare notes. The forehead blue was very brilliant, an electric blue, the other details were as described in 'Birds of Southern India' though I should say that the legs were rather lighter in colour than mentioned. The white of the abdomen was very pure.

I was happy when the little visitor flew safely off. As this place is only some 30 miles south of St. Thomas' Mount where Baker says that he saw his only specimen, we perhaps may hope that it is not quite such a rare visitor as he thought. I should, however, say that it was quite definitely a migrant. The whole behaviour of the bird reminded one of the Pittas who at this same time of year so often blunder on their way, getting trapped on verandahs, bumping into walls, and in general behaving quite unlike the same bird when living in the countryside. My wife thinks that she saw the same bird about this time last year. I am afraid that I had rather doubted her description then.

2. On 27-11-52 a male Orangeheaded Ground Thrush (*Geokichla c. citrina*) spent the day in this compound. He was remarkably tame and spent a lot of time in the garden near the house.

3. Perhaps I should mention the Forest Wagtail (*Dendronanthus indicus*) as another uncommon visitor. Its call is very distinctive and I have seen them occasionally on passage in Arkonam, North Arcot. My Chingleput record for this is 14-4-1952.

CHINGLEPUT,
S. INDIA,
April 2, 1954.

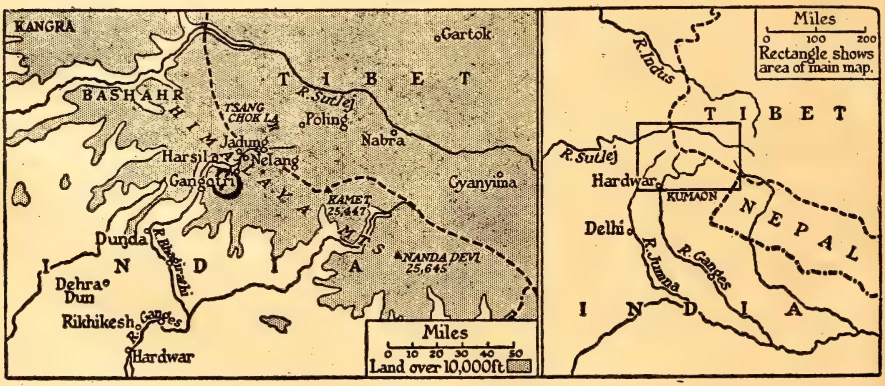
REV. E. O. SHAW

27. BIRDS SEEN ABOVE THE TREE-LINE IN TEHRI-GARHWAL, IN THE CENTRAL HIMALAYAS

(*With two plates*)

The observations on which this note is based were made on the Oxford University Expedition to Tehri-Garhwal in 1952.

Tehri-Garhwal is a small state lying athwart the Himalayan Range. It is bordered on the north by Tibet and on the north-west and west by the Punjab. To the east lie Garhwal and Nepal and to the south Kumaon and the plains of the western United Provinces, now known as Uttar Pradesh. To those who know Northern India, it is best described as the country to the north and north-west of the well-known hill station of Mussoorie.


KANGRA
Gartok
T I B E T
R. Sutlej
BASHAHR
H I M A L A Y A
TSANG CHOK LA
Poling
Jadung
Nabra
Harsila
Nelang
Gangotri
Gyanyima
KAMET 25,447
M T S
NANDA DEVI 25,645
Dunda
R. Bhagirathi
I N D I A
Dehra Dun
Rikhikesh
Ganges
R
Hardwar
Miles
0 10 20 30 40 50
Land over 10,000ft.
Miles
0 100 200
Rectangle shows area of main map.
R. Indus
T I B E T
R. Sutlej
Hardwar
KUMAON
N E P A L
Delhi
R. Jumna
R. Ganges
I N D I A

The Rudugaira Valley lies in the area indicated by a circle on the first map.

During September and October the expedition worked in the Rudugaira Gad, a small alpine valley whose stream rises from a glacier directly on the north side of the main Himalayan Range and flows northwards for a distance of eight miles, falling from 16,000 ft. at its source to 10,000 ft. at its junction with the Bagirathi River, the main headwater of the Ganges. At its upper end the valley and its glacier are flanked by several mountains rising to 21,000 ft. and over. The considerable altitude of this region thus provided opportunity for observing the birds up to and well above the snow-line.

CLIMATE

Throughout September the weather was mainly fine. A little rain fell early in the month, marking the end of the monsoon. Winter snow began to fall early in October. At 15,000 ft. shade temperature ranged from 24°F. at night to 70°F. during the middle of the day. There was little wind at this altitude but light breezes often blew above 16,000 ft. Morning usually broke fine and clouds would gradually build up around the peaks and ridges above 17,000 ft. Towards evening these clouds would clear and others would form in patches along the slopes at about 12,000 ft., to disperse in the early morning.

ALTITUDE ZONES AND VEGETATION

The observations were made between 13,500 ft. and 22,000 ft. The altitudes quoted below were obtained by reference to the map (Survey of India). The extent of the zones is diagrammatically portrayed below.

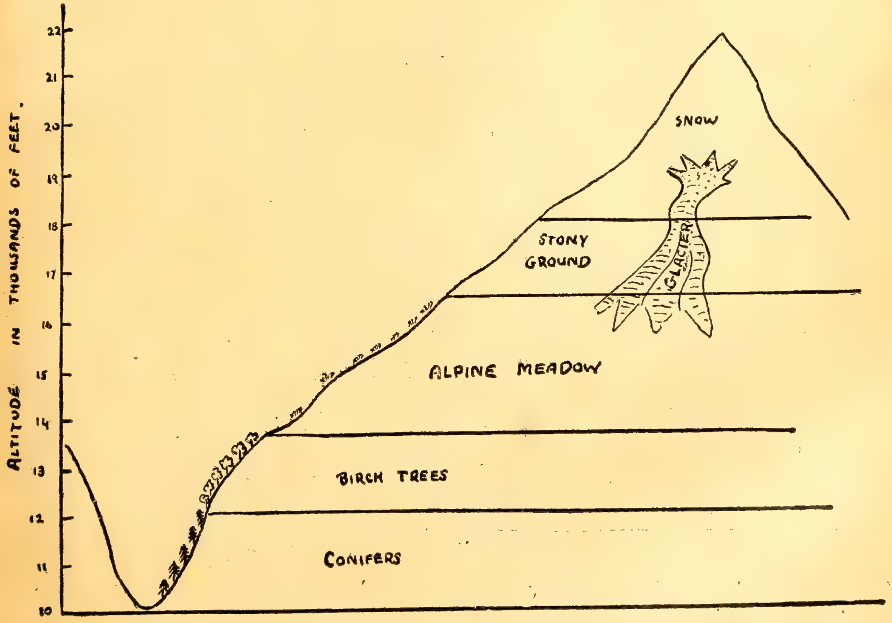


Diagram of altitude zones.

8,000 to 12,000 ft. ...	Conifers
12,000 ,, 13,500 ,, ...	Birch trees
13,500 ,, 16,500 ,, ...	Alpine meadow
16,500 ,, 17,500 ,, ...	Barren stony ground
17,500 ,, 22,000 ,, ...	Perpetual snow

Descriptions of the last three of these zones follow.

Alpine meadow. Above the birch trees, one enters an area of grassland where, during the summer, flowers of great beauty abound. In relatively sheltered parts dwarf willow and dwarf juniper grow. Small streams, rising from springs in the meadow and from the melting snow and ice above are accompanied by belts of particularly luxuriant herb vegetation. Towards the upper limit of the meadow the grass becomes browner and sparser and at 16,500 ft. it gives way to the open stony ground. Small cliffs and rocky outcrops are to be seen everywhere on the meadow.

Stony ground. Here the general appearance is that of a wilderness of scattered boulders. Between the stones grow a few tiny alpine flowers.

Perpetual snow. This is a region with no vegetation where snow, ice and steep bare rock only are to be seen.

AVIAN FAUNA

Within the limits of the higher three zones defined above, the author recorded 23 species of birds. A few of these were common on both the alpine meadow and the stony zone. Of the six species seen above the snow-line none can be regarded as a regular inhabitant there.

Corvus macrorhynchos. Jungle Crow

The Indian Jungle Crow (presumably the Himalayan race *intermedius*) occurs commonly in the valley but apparently only in association with man and domestic animals. Several frequented the expedition camps at 13,500 and 15,000 ft. and many followed the flocks of sheep and goats which were grazing on the meadow. Groups of up to twelve birds were seen.

Pyrrhocorax pyrrhocorax. Redbilled Chough

Flocks of 10-60 choughs ranged up to 14,000 ft. and were commonly to be seen just above the tree line. They were never observed higher than 14,000 ft., above which height they were replaced by the Alpine Chough, *Pyrrhocorax graculus*. The flocks were seen feeding at the lower limit of the meadow and retiring to the branches of the birch trees and to the rocks when they were disturbed. Indeed, the birch trees appeared to mark the virtual upper limit of their range for they rarely moved more than a hundred feet above the trees. In the evenings the choughs left the valley to roost on the high cliffs at 12,000 ft. above the Bhagirati River.

Pyrrhocorax graculus. Yellowbilled or Alpine Chough

The Alpine Chough was seen in flocks of 20-100 from 14,000 ft. to 18,000 ft. and smaller groups were seen up to 21,000 ft. The flocks fed on the meadow, very commonly choosing the 'karaks' areas where the sheep and goats were herded for the night. In the evenings small groups were observed flying to the high cliffs over the glacier to roost at about 17,000 ft. Most interesting were the

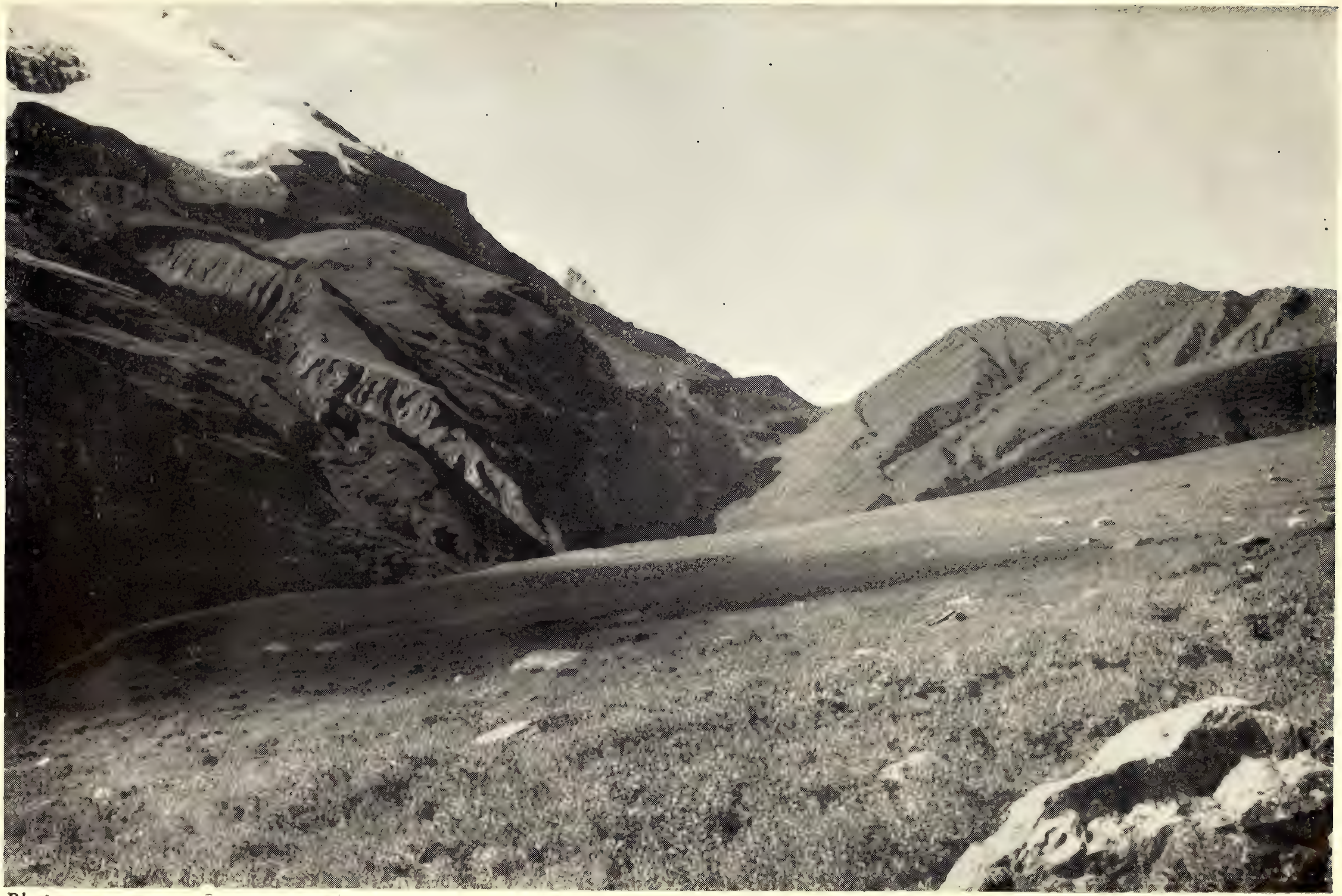


Photo *Author*

A view of the Alpine Meadow. Behind on the right is the terminal moraine of the glacier. On the left is the stony zone and the bottom of the snow zone

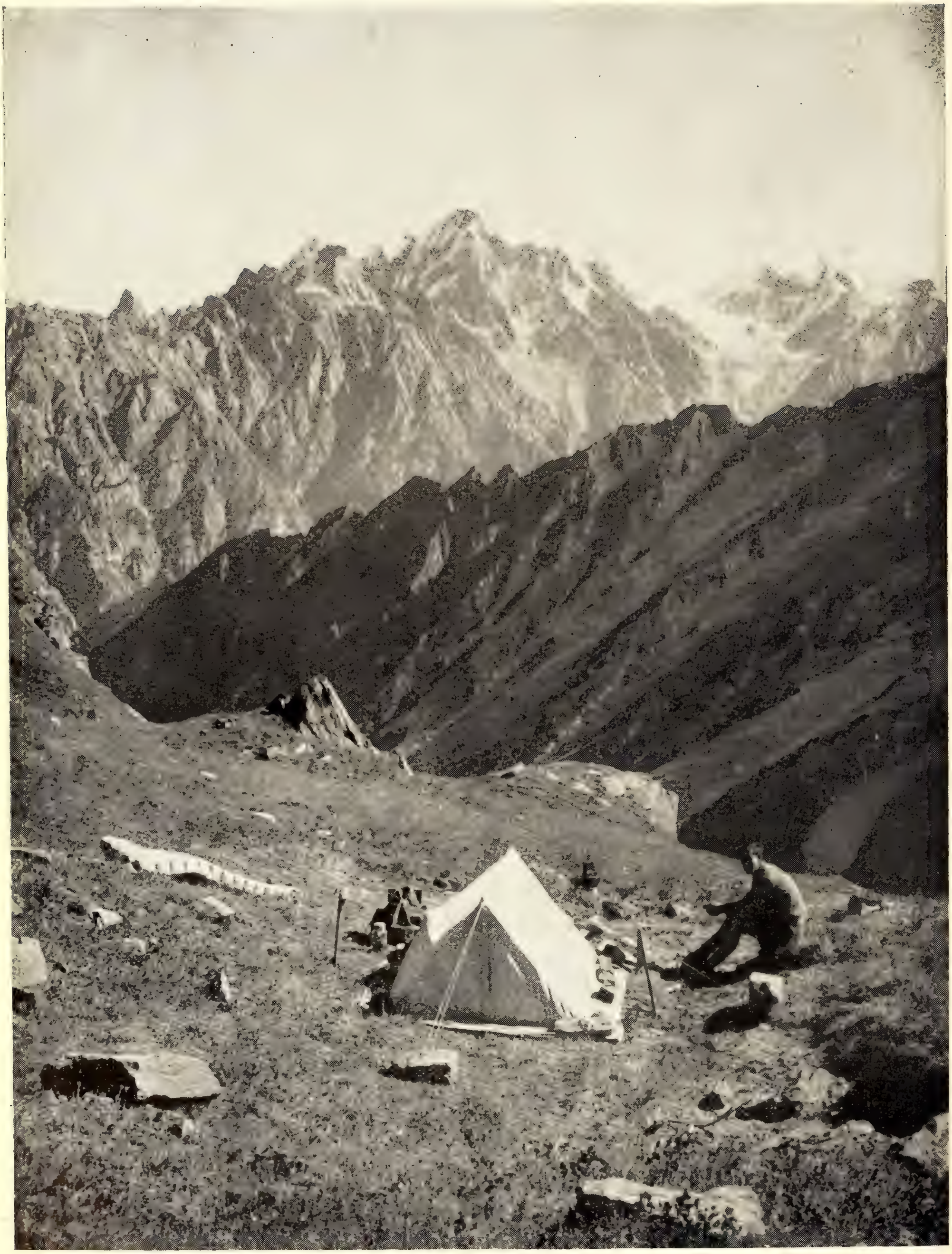


Photo *Author*

A view of the meadow showing typical rock outcrops. Areas in the stony and snow zones can be seen in the background extraordinary aerial evolutions performed by these birds. A flock soaring among the crags would suddenly descend, one by one, in a way that can only be likened to that of falling bombs. Each bird, with its wings nearly closed would dive for a vertical distance of 3,000 ft. at a very steep angle, terminating its dive with an upward swoop on to a cliff ledge. The sound produced by the falling birds was a distinct low whistle which could be heard some distance away.

It is interesting to note how completely the two species of chough were segregated. On only one occasion, I saw both species feeding close together at about 14,000 ft. The flocks were separated by a distance of 40 yds.

At 21,000 ft., we came upon three birds circling and diving round the corner of an ice cliff.

Tichodroma muraria. Wall Creeper

Six were seen separately at heights of up to 18,000 ft. Five were flying and were not seen to alight, but one landed on a small cliff face at 17,000 ft. and ran about apparently looking for food. The only small animal that I could find on the rocks at this height was a red-brown mite. One bird flew at least a mile across the snow covered mountain-side before passing out of sight.

Cinclus cinclus. Whitebreasted Asiatic Dipper

A single Dipper of this species was seen along the Rudugaira Stream at 13,600 ft. The Brown Dipper, *Cinclus pallasii*, which is common below 10,000 ft. was not seen above the tree-line.

Phœnicurus frontalis. Bluefronted Redstart

Several pairs were present on the meadow, living close to large exposed rocks.

Chaimarrhornis leucocephala. Whitecapped Redstart

Common below 13,000 ft., but only three were seen between 13,500 and 15,000 ft. along the Rudugaira Stream.

Rhyacornis fuliginosa. Plumbeous Redstart

Twice seen at 14,000 ft. among the boulders in the stream.

Prunella rubeculoides. Robin Accentor

Two pairs of this large accentor were seen in the valley. Their habitat, in both cases, was an area covered with large boulders and steep outcrops of rock. One pair living at 16,000 ft. were seen carrying food to an inaccessible crevice on a small cliff where they appeared to have a nest. The date was September 17. The other pair were living at 15,300 ft.

On September 15, another Prunellid was seen momentarily as it flew from the thick vegetation bordering a stream at 13,500 ft. It appeared similar in colour and size to the European Hedge Sparrow, *P. modularis.*

Carpodacus sp. Rosefinch

Two pairs of Rosefinches of a species that I was unable to identify were found living in exactly similar habitats at 15,000 ft. and 16,000 ft.

to those of the accentor *P. rubeculoides.* Both pairs were apparently feeding young on September 17, but I could not find their nests.

Montifringilla sp. (probably *M. taczanowski*). Mountain Finch

This species was common on the meadow between 14,000 ft. and 16,500 ft. and as has been noted before (Ludlow & Kinnear) for *M. taczanowski*, was mainly to be seen in the vicinity of mouse-hare colonies.

Delichon urbica. House Martin

A colony nested half way up a 200-ft. cliff at 13,000 ft. and many were seen catching insects at heights up to 15,000 ft. Young apparently remained in the nest until the first week of September.

Motacilla alba. White Wagtail

White Wagtails frequented our camps at all levels below the snow-line. At 16,000 ft. an adult *leucopsis* in summer plumage and two young birds were constantly about our camp on the glacier moraine during the first week in October. It is possible that the young wagtails seen at the different levels belonged to one or more of the other races of White Wagtail which are to be found in the Himalayas at this time of year, namely *M. a. dukhunensis*, *M. a. personata*, and *M. a. alboides.*

Motacilla cinerea. Grey Wagtail

A single Grey Wagtail was disturbed at a stream on the meadow at 14,000 ft.

Anthus roseatus. Hodgson's Pipit

Only this one species of pipit was identified above the tree-line. Flock 20-50 frequented the meadow. A nest with four half-incubated eggs was found at 13,600 ft. on September 2.

Upupa epops. Hoopoe

On September 9, at 18,500 ft., a Hoopoe flew past me, having apparently crossed the main range at a point 19,000 ft. high.

Gyps himalayensis. Griffon Vulture

Himalayan Griffons were occasionally to be seen very high over the valley. However, five minutes after a blue sheep had been shot, one appeared overhead and within ten minutes there were fifteen. Griffons were observed flying near the limit of visibility with binoculars and it was estimated that their altitude was above 25,000 ft. If the apparently clear sky was searched with binoculars we were sometimes able to see Griffons at very great heights.

Gypaëtus barbatus. Lämmergeier

One example lived in the valley. Within four weeks of our arrival it had become very tame and would sit near our camps. It was seen flying along cliff faces at 18,000 ft. This bird roosted on a cliff ledge at 14,000 ft.

Falco tinnunculus. Kestrel

Kestrels were commonly seen up to 16,000 ft. Their main food was a single species of grasshopper that was very numerous on the meadow (*Anaptygus* sp. n.). I saw one kestrel carrying a small lizard, (*Lacerta* sp.). Below 14,000 ft. voles (*Alticola roylei*) were abundant, but I did not see a kestrel take one.

Columba leuconata. Snow Pigeon

Observed in flocks of about twenty. During the day, the birds came to the small streams at 13,000 ft. They were often seen flying rapidly from one cliff to another, usually above 14,000 ft. In the evenings they went to the cliffs at 17,000 ft. above the glacier where they probably roosted.

Lophophorus impejanus. Monal Pheasant

The Monal lived singly or in groups of two or three on the grassy slopes just above the tree-line. When flushed they invariably flew downwards across to the other side of the valley, uttering their curlew-like alarm whistle.

Alectoris graeca. Chukor

A single covey of nine chukor was disturbed on the glacier moraine at 15,000 ft.

Tetraogallus himalayensis. Snow Cock

The Snow Cock lives in considerable numbers on the meadow in family parties of 8-10. I followed one covey from sunrise to sunset. An hour before sunrise, eight birds passed over my tent at 15,000 ft., plumetting at great speed down the hillside and producing a harmonious low pitched whistle. This sound, caused by disturbance of the air, awoke me on four different mornings. Alighting on the meadow at about 14,000 ft., they began to feed, walking slowly up the hillside as they did so. By sunset they had reached the top of a ridge at 17,000 ft., where apparently, they roosted during the night. On the following morning, they descended an hour before sunrise to repeat the performace. On one occasion we disturbed two on the snow at 18,500 ft., and we found their footprints up to 19,000 ft. I never saw these birds fly up-hill or even horizontally, nor did I see them beat their wings except just before alighting. Every flight that I saw was at steep angle downwards, on rigid wings.

While feeding, the birds continually uttered their very striking call, a rising scale of four clearly whistled notes covering rather more than an octave.

P.O. Box 397, H. F. LAMPREY
ARUSHA, TANGANYIKA.

28. THE SECONDARY SONG OF BIRDS

Mr. M. D. Lister's article on the above subject, in vol. 51 of this *Journal* (pp. 699-706), put me in mind of a number of occasions when I had heard birds quietly warbling to themselves an almost endless melody bearing no resemblance to their normal songs or call notes. Instances found recorded in my notes are listed below. Locality, except when stated otherwise, Palghat taluk, Malabar, South India.

WHITEBROWED BULBUL (*Pycnonotus luteolus*)

2 May, 1948. Time? weather dull and cloudy. Bird sat alone in a bush and warbled for a long time in a low tone.

I had heard a similar warbling a number of times before that date, but had not associated it with this normally vociferous bird.

5 April, 1951. 3 p.m. Same as above. Among the birds mimicked were Large Cuckoo-Shrike, Chloropsis, Redvented Bulbul and Green Bee-eater.

During April 1951 the warbling was heard a number of times.

September, 1952. Warbling was heard often, but notes were not kept.

As a rule, this bird warbled only in the afternoons, and that too, in dull weather. It was the strange tendency of the bird to mimic birds of other species in the course of this quiet song that first attracted my attention. The bird normally sat well within some low, thick bush; only once was it found sitting 12 ft. above ground on a fairly exposed perch in a guava tree.

April 1952. During this month also the warbling of the Whitebrowed Bulbul was heard off and on.

5 November, 1953. 2.10 p.m. Sunny, but film of clouds covering the sky. A few minutes later it became very dull. Three Whitebrowed Bulbuls were on a neem tree where there was a Grey Drongo also. One of the bulbuls sang short snatches of the quiet song every now and then. Curiously enough, the bird was actively feeding all the time. It mimicked the Chloropsis, the Drongo, and some other birds. This was the only occasion when the Bulbul was heard singing like this when other birds of the same species were present. Perhaps it was this, and the fact that the bird was actively engaged in feeding, that made the song brief.

MAGPIE ROBIN (*Copsychus saularis*)

May-June, 1953. A pair of Magpie Robins went about in our compound feeding a couple of chicks. After the first week of June they were not seen or heard anywhere here till the 30th of September, when one bird put in a brief appearance. It uttered only a few short but loud notes.

1 October, 1953. Sky cloudy. 8 a.m. A single bird sat idly on a low perch and warbled for 3 minutes. Then it uttered loud, harsh notes.

2 October, 1953. Dull weather. A Magpie Robin uttered snatches of song loudly for a short while. On subsequent days only loud, harsh notes were heard. Two birds began to appear together.

6 October, 1953. 5.15 p.m. A male sat on a branch 6 to 7 ft. above ground and warbled in a subdued tone for a long time. It was an endless, intricate tune with imitations of bulbuls and mynas thrown in. The bird's bill was not open, but the throat rose and fell with the variations in tune. On seeing me the bird hopped away to another

branch, but resumed its song without delay. There did not appear to be any other Magpie Robin nearby.

For some days after this the bird's harsh scolding notes and loud, brief, staccato songs only were heard.

14 October, 1953. 9.30 a.m. Dull weather. A bird sat in the heart of a yellow oleander bush and warbled in an undertone for a long time. Another Magpie Robin, some thirty or forty yards away, was uttering short, loud call notes at the same time. The first bird's song would not have been audible to human ears at ten yards' distance.

15 October, 1953. 12.30 to 1.30 p.m. Dull weather. Two Magpie Robins were singing the quiet song, sitting less than 10 yards away from one another. They were in two different compounds with a narrow lane in between. There was no suggestion of rivalry in their songs.

I could watch only one of the birds. Noticed again that the mouth appeared to be closed, but the throat got inflated and deflated very conspicuously, and with great rapidity, while the bird sang. This bird once jumped down to the ground to catch an insect, but on returning to the perch took up the tune again. At first the bird was facing the other, hidden, songster, but after this sally, it faced the opposite direction. Never once, in the course of this prolonged duet, did either of the birds raise their voice or utter any harsh notes.

4 November, 1953. 7.15 to 7.30 a.m. Sunny, but not warm. A Magpie Robin male, sitting on neem tree branch 20 ft. above ground, burst into loud song. (From September 30th till this date the loud song referred to was a sharp, rapid *chee-which-which* . . . . *chee-chee-witch-chee-chi* . . . , and not at all the tuneful song uttered during the breeding season.) After a brief interval, it began the ultra-quiet song and went on for a minute. Again, bill was not open, throat rose and fell. When some other bird (an Iora?) uttered a few sharp notes, the Magpie Robin put an abrupt stop to its warbling and became alert. A couple of minutes later, it whistled a few bars of the staccato songs loudly and flew off to another neem tree some 15 yds. away. Some time after this, when I went that way to look at a Paradise Flycatcher, I heard the low warbling of the Magpie Robin again. Though I knew that the bird was somewhere there, and could hear the faint melody, it took me some time to discover the songster. It was sitting only 10 or 12 ft. away on the neem tree, 8 ft. above ground level.

Normally the Magpie Robin makes few movements when singing like this, but on this occasion the bird pressed its tail down, flicked it up, pressed it down again and so on a number of times. Catching sight of me, it jumped to another twig, sang for a time in the same quiet tone, and jumped rapidly from twig to twig until it was hidden by a thick branch. There it sat for a time warbling quietly, before flying away. On this occasion the bird uttered its nasal screech and the long single whistle also in the same subdued voice.

The maximum range at which a careful listener would be able to notice this quiet song may be put down as 25 to 30 ft.

INDIAN ROBIN (*Saxicoloides fulicata*)

16 October, 1953—Ottapalam, near Shoranur, Malabar. 5.30 p.m. Sunny. A solitary male sitting on a telephone pole near the only tree in an open stretch of paddy fields, warbled on in a low tone. Song was reminiscent of Magpie Robin's quiet song. The next day, at the same time (cloudy), bird was singing loudly from the same perch.

WHITETHROATED GROUND-THRUSH (*Geokichla citrina*)

5 May, 1945. 7 a.m. Cloudy, and drizzling lightly. Bird sat 5 ft. above ground on a teak sapling in mixed jungle and sang a very tuneful, but remarkably low melody for a long time. Found it difficult to discover the bird, though we were only a few yards away, because of the low quality of the song. The bird was not seen before or after this date in this wood.

SOUTHERN GREYBACKED SHRIKE (*Lanius schach*)

My note in the April 1952 issue of the *Journal* (Vol. 50, p. 666) describes the quiet song of this shrike, though the fact that the bird's voice, while engaged in mimicry, was very low was unfortunately omitted. That shrike's song would not have been heard distinctly at a distance of 30 yards, though its harsh call notes were audible 200 or even 300 yards away. I have not heard 'the pleasing little tinkling song' (Sálim Ali: The Book of Indian Birds) which the bird is said to utter during the breeding season, and so cannot say whether what I heard was distinct from the true song. The song I heard was very low and, as was pointed out in the earlier note, very rarely uttered.

The dates on which the shrike sang are given below.

15 May, 1947. 5 p.m. Sunny. Sang for 25 minutes.
16 May, 1947. 5 p.m. Sunny. Only for a very brief period.
19 May, 1947. 4.30 to 5.30 p.m. Almost all the time.
20 May, 1947. 5.05 to 5.11 p.m.

BROWN SHRIKE (*Lanius cristatus*)

29 December, 1949. Late evening. Bird sitting on bamboo twig uttered various low musical notes without a break for a long time. Song was very low and contained imitations of pipit's song and that of some other small birds (sunbirds? and warblers?). Could not at first believe that it was the Brown Shrike which was warbling and had to watch it closely to make sure that I was not deceived. Bill was not open at any time, but the bird's throat vibrated and rose and fell while it was singing, as described in the case of the Magpie Robin.

21 December, 1950. 5 p.m. A bird perched on low teak sapling, chirruped away merrily for about half an hour in an undertone. Song seemed to contain imitations of the Yellowthroated Sparrow's twittering.

BRAHMINY MYNAS (*Temenuchus pagodarum*) have been occasionally found sitting alone and very quietly singing to themselves. The only instance found recorded in my notes is the following.

8 May, 1945. 4 p.m. Cloudy. Drizzled for half an hour soon after.

Common Mynas (*Acridotheres tristis*) have also been observed singing this quiet song, but I have not been able to find any definite records in my notes. Individuals of both species are invariably alone, sitting in the foliage of some mango or jak tree, while indulging in this *sotto voce* song. I am under the impression that they sing in this fashion only on hot afternoons when there is no breeze, and when the weather is very oppressive. Both species weave the call notes of other birds into their songs.

Grey Wagtail (*Motacilla cinerea*, most probably.)

8 December, 1950, 3 p.m. A couple of Grey Wagtails sitting on roof twittered continuously for a long time. Whether only one or both birds sang could not be ascertained.

6 October, 1951. Morning. Cloudy. A bird sang a delightful series of tunes in an undertone.

13 October, 1953. 1.15 p.m. Heard a low twittering going on without a pause for a long time. Went out to find out where the bird was. There were two wagtails on the roof. They flew off the moment I came out, and so once again I was left wondering whether one or both birds had sung.

Purple Sunbird (*Cinnyris asiatica*)

Male Purple Sunbirds in eclipse plumage have often been found sitting 20 to 30 ft. above ground level, usually on the bare outer twig of a teak, and uttering a low twittering song which goes on for a long time without any appreciable pause. Other birds of the same species are not found at the time anywhere near this. Only two instances seem to have been recorded in my notes.

2 May, 1948. 12 noon. Sunny, but heavy clouds in the SW. Bird sat on moringa tree and sang for 5 to 10 minutes.

12 June, 1951. Noon. Cloudy. Bird was on top of tall teak sapling.

The male sunbirds seem to indulge in this quiet song more frequently than any of the other birds here mentioned. But only birds in non-breeding dress sing thus. It is invariably in the afternoon hours, between 12 and 4. Magpie Robins, Whitebrowed Bulbuls, the shrikes and the mynas make very few movements when singing the quiet song—the first two species having even a sort of absent-minded, dreamy air about them—but the sunbird does not keep still. It remains on the same perch, but goes on oscillating very rapidly. The bill appears closed, and is always pointed up at a 45-degree angle.

General Remarks

As will be seen from the above notes, some birds which cannot be said to have any true song (Common Myna, Brahminy Myna and Whitebrowed Bulbul for example) have been found warbling in an undertone for surprisingly long periods.

Birds which normally do not indulge in mimicry (i.e., which do not loudly reproduce the call notes or songs of other birds) introduce such imitations freely into their subsong. Whether the Grey Shrike also mimics other birds only when singing in an undertone is not clear.

The tendency to give vent to this sort of low soliloquy seems to be greater when the weather is dull.

As a rule the birds are alone, inactive and in a brown study when they are singing the quiet song.

PALGHAT, K. K. NEELAKANTAN
December 9, 1953.

29. PYTHONS

It may interest your readers to know that in February last, after a cold wet day and night, I was out the next morning on an elephant after the sun had just got up, when I came across five full-grown pythons all on a large ant-hill, broken down to some extent by bear and elephant. They were lying criss-cross. I approached to within 15 yards or so, when they all gradually moved round and faced me. After having a good look at us for five minutes or so, they gradually slid down and disappeared in the surrounding growth. They all appeared to have new skins.

Further on, about 60 yds. away, was another full-grown python sunning itself. That gradually slid away and the mahout and I thought it was fully 15 ft. long.

That too had a new skin, i.e. light and shiny. I have never seen more than two pythons together before.

EVERGREEN COTTAGE,
UPPER SHILLONG, FRANK NICHOLLS
SHILLONG, ASSAM, 1954.

30. NOTES ON THE FROG *RANA BREVICEPS* SCHNEIDER

(*With a sketch*)

Mr. Humayun Abdulali of the Bombay Natural History Society sent to us a small collection of nicely preserved frogs of *Rana breviceps* Schneider, collected at Trivandrum, Travancore, in November 1953 by Mr. J. C. Daniel, indicating the presence of a small but distinct tubercle at the tibiotarsal articulation. The collection consisted of seven females and one male. The specimens in the Reserve collection of the Zoological Survey of India were examined, but as there was no representative from Trivandrum, Dr. H. W. Parker of the British Museum of Natural History was approached if he could examine the material in his charge, especially the Trivandrum frogs referred to by Boulenger in his monograph[1]. At his request, Miss A. G. C. Grandison very kindly examined all the specimens of *R. breviceps* for the presence of the tubercle referred to above. We take this opportunity of thanking both of them for their help.

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[1] Boulenger, G. A. (1920), *Rec. Ind. Mus.*, **20** : 105

Material examined.—The specimens were examined from the following localities which are listed geographically. The figures in parenthesis after each locality denote the number of frogs examined.

Zoological Survey of India	Bombay Natural History Society [1]	British Museum (Natural History)	Tibio-tarsal tubercle
Ceylon (1)	—	Ceylon (11)	Present
—	—	Trivandrum (2)	do.
Bangalore (3)	—	—	do.
—	Cuddappah (5)	—	do.
Ratnagiri (1)	—	—	do.
Madras (1)	—	—	do.
Madras (1)	—	—	Absent
Anaimalai Hills (2)	—	Malabar (6)	do.
'S. India' (1)	—	—	do.
—	Khandala (2)	—	do.
—	Kanheri Caves, Bombay (9)	—	do.
Nagpur (3)	—	Chanda, M.P. [2] (1)	do.
N.W.F. Province (1)	—	—	do.
Allahabad (3)	—	—	do.
Agra (10)	—	—	do.
Himalayas (2)	—	Himalayas (1)	do.
Nepal (1)	—	—	do.
Assam (2)	—	—	do.
—	—	Burma (2)	do.

The fleshy cutaneous tubercle is a very small roundish structure, creamy yellow in colour, placed ventrally at the tibiotarsal articulation and in a line with the shovel-shaped inner metatarsal tubercle (fig. 1). It may be noted that in a few frogs, the tubercle is overhung by a crease of skin which may be due to preservation.

Owing to the damaged condition of the hind legs of our only Ceylon specimen, it is not possible to make out the presence of the tubercle, but since it is reported as present by Miss Grandison in all the Ceylon specimens at the British Museum, we have included it along with them. She mentions that 'it is no larger than the tip of a digit'.

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[1] All the specimens under this column were examined by the senior author when he paid a short visit to the Society's Museum in August, 1954.

[2] Madhya Pradesh, formerly known as Central Provinces.

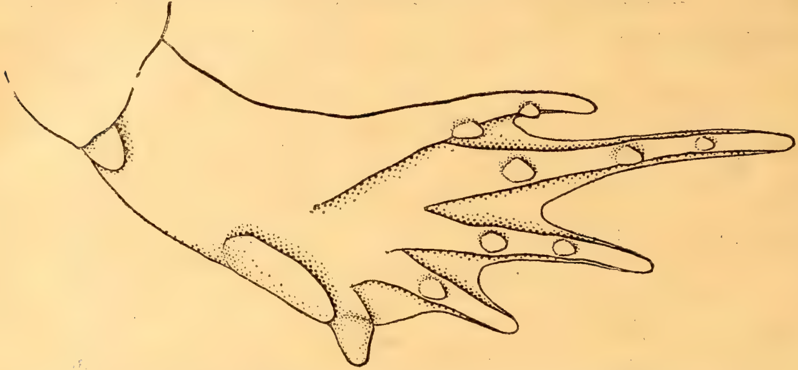

Fig. 1. Right foot of *Rana breviceps* from ventral side, showing the inner metatarsal tubercle and the tibio-tarsal tubercle.

The tubercle is prominently present in all the eight Trivandrum frogs before us. Miss Grandison also reports its presence in the Trivandrum frogs at the British Museum. The three Bangalore specimens show this tubercle, though a trifle less conspicuously than the Trivandrum specimens. All the five specimens from Cuddappah in Andhra State are small and immature, nevertheless the tubercles are distinct in all of them. The only Ratnagiri specimen has the tubercle, but it is very small and apt to be overlooked. It is interesting to observe that of the two Madras frogs, only one exhibits a very small tubercle, while no trace can be seen in the other. Both were collected by Dr. J. R. Anderson in 'Madras (town)' in November, 1917.

Among the frogs of other south Indian localities, the tubercle is absent in those from Malabar and Anaimalai Hills. It is also absent in the only specimen bearing the vague locality—'S. India'. The frogs from Bombay, Madhya Pradesh (formerly Central Provinces) and northwards in other north Indian localities including Nepal and Burma, do not show the tubercle. In a general way, it may, therefore, be observed that the presence of the tubercle seems to be confined to the frogs from South India and Ceylon with the exception of the localities mentioned above.

The prominent nature of the tubercle in the Travancore frogs, and less so in those of other south Indian localities tends to suggest a sort of geographical variability of the character or its gradual absence. As our observations are based on a very small collection, it seems that an attempt should be made to examine fresh material collected in fair numbers from as many south Indian localities as possible, which will not only throw light on the trend of evolution of this small but certainly very interesting character, but may also help to separate the tuberculated forms either as a distinct species or as a geographical race.

Geographical Distribution.—Boulenger (loc. cit.) states: 'India, Ceylon and Upper Burma. *Restricted to the plains of Southern India*' (italics ours). The localities listed above, however, amply indicate that *R. breviceps* occurs in many parts of northern India as well, though it may not be as common as in southern India.

ZOOLOGICAL SURVEY OF INDIA,
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J. L. BHADURI
MIRA KIRPALANI

31. A RECORD OF THE WHALE SHARK (*RHINEODON TYPUS* SMITH) FROM THE MALABAR COAST[1]

On the 12th of February 1954 two whale sharks got entangled in a *vakkuvala* (a type of boat-seine net) operated by the local fishermen for capturing catfishes at 9-10 fathoms in the sea off Madapally (about 25 miles north of Calicut). As it was difficult to haul the net even with 80 fishermen in 10 canoes, one of the whale sharks (the female) was allowed to escape. The other, a male, was landed ashore at about 4 p.m. after a struggle of over four hours. It lived till the next morning.

This specimen measured 21 ft. and 3 in. in length and weighed 2½ tons, and showed the following characters: It was dark-grey in colour with yellowish spots (about 3 in. in diameter) and small bars (1 in. wide) set irregularly on the dorsal half of the body. Its mouth was straight and nearly at the end of the head. Each jaw had a band of very small curved teeth. The mouth was 96 inches wide, with its cavity jet-black in colour. The upper part of the body had ridges, running along its length, one down the middle of the back and two on either side. The eyes were small (one inch in diameter) with smaller spiracles placed closely behind. The five external gill-slits on either side were 25 in. wide, the last of them being situated above the base of the pectoral fin, which was sickle-shaped and 43 in. in height. The girth of the body behind the pectorals was 12 ft. The first dorsal fin was 30 in. high and 24 in. broad; and the upper lobe of the caudal fin was 5 ft. in length.

The shark was cut into pieces and sold for Rs. 290 to local merchants who cured the white and soft flesh by using 16 maunds of salt. The stomach was found empty. The liver weighed 266 pounds, and was purchased by the Fisheries departmental staff for Rs. 83-2-0, and sent to the Government Oil Factory, Calicut, for extraction of oil. The saponification value of this oil was 215.7, much higher than the usual run of values of other shark-liver oils, and the Vitamin A potency was 763 international units per gramme (analysis kindly furnished by Sri U. Sundar Kini).

As this is the first record of whale shark on this coast, the monster attracted thousands of people within a radius of 20 miles from Madapally. It is probable that this pair of sharks was swimming in the fishing ground of the local fishermen and inadvertently fouled their net. The fishermen reported that shoals of pomfrets (*Stromateus cinereus* White) were swimming under and in close association with the whale sharks.

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[1] Published with the permission of the Director of Industries and Commerce, Madras.

Previous records of whale sharks from Indian waters are few. Hailey (1883, 1890), Day (1889), Thurston (1890, 1894), Regan (1908), Southwell (1912-13), Deraniyagala (1936, 1944) and Gudger (1940) have reported this from Ceylon waters; Lloyd (1908) from the Bay of Bengal; Pillay (1929) from Travancore coast; Prater (1941) from Karachi and Bombay; and Kulkarni (1948) from Bombay waters. One of us (P. I. C.) during his inspection of the pearl bank, Thollayiram paar, in the Gulf of Manaar, on 11th December 1953, observed a whale shark about 25 ft. in length, swimming motionless in the vicinity in spite of the motor fishing vessel being taken around it several times.

Marine Biological Station, West Hill,
Malabar,
March 22, 1954.

P. I. CHACKO
M. J. MATHEW

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32. FOOD ORGANISMS OF *GADUSIA CHAPRA* (HAM.) FROM CERTAIN PONDS WITH THICK *EUGLENA* BLOOMS

Gadusia chapra is a common herring of the Mahanadi river system. The juvenile stages of this fish are often caught in large numbers with the carp and other fresh-water fry. The fish attains a length of about six to seven inches.

While working on the gut contents of different fishes from some ponds having thick blooms of *Euglena*, certain interesting features were observed on the feeding habits of *Gadusia chapra*.

Investigations on the food of *Gadusia chapra* have been based on the analysis of the contents of the stomach of 110 specimens from four ponds. Three of these ponds belong to the Kendrapara fish farm, while the other is in Dry Dock (Cuttack). In all cases it was observed that the fish were fed to the extent of 92% to 100%. For the sake of experimental convenience, the fish were divided into three different stages depending on the size of the specimens. Specimens ranging from 60 mm. to 90 mm. were put in stage I, those between 90 mm. and 100 mm. were put in stage II and those between 120 mm. and 145 mm. in stage III. All these records were made during the months of December, January and February 1949-50 and 1950-51.

The food of *Gadusia chapra* as analysed was mostly composed of Flagellates. The different genera of organisms that have been identified in the stomachs are as follows :—

(1) Euglenids—*Euglena* (species—*acus, oxyrius, spirogyra*, and *viridus*); *Phacus* and *Lepocinclis*. The first genus was seen to predominate in the gut ranging from 60% to 80%.

(2) Dinoflagellids—*Peridinium*, *Gymnodinium*, and *Ceratium*, the first found to be in greater numbers.

(3) Diatoms—*Synedra*, *Tabellaria*, *Navicula*, *Amphora*, *Pleurosigma*, *Fragilaria*, *Stauroneis* and *Cyclotella*.

(4) Microscopic Green Algae—*Closterium*, *Staurastrum*, *Euastrum*, *Coelastrum*, *Ophiocytium*, *Scenedesmus*, *Chlorella*, *Crucigenia*, *Kirchneriella*, *Pediastrum*, *Ankistrodesmus* and *Pleurococcus*.

(5) Filamentous Green Algae—*Spirogyra* was seen in only two instances.

(6) Blue Green Algae—*Merismopedia*, *Aphanocapsa*, *Tetrapedia*, *Chroococcus* and *Oscillatoria*.

(7) Rotifers—*Rattulus*, *Brachionus*, *Rotifer*, *Asphanchna* and unidentified forms due to decomposition. Eggs of Rotifers were found in the stomach in some of the cases.

(8) Crustaceans—Broken appendages of Cladocers were rarely observed in negligible proportions.

Mud, sand and waste matter were observed in all the specimens.

TABLE SHOWING THE TOTAL NUMBER OF FISH EXAMINED AND THE AVERAGE PERCENTAGE OF FOOD EATEN.

Stage of fish Total number of fish examined	Stage I 14	Stage II 73	Stage III 23
Euglenids ...	78%	72%	68%
Dinoflagellids ...	6%	8%	8%
Diatoms ...	3%	3%	4%
Smaller Green Algae ...	3%	2%	1%
Filamentous Green Algae ...	negligible	—	—
Blue Green Algae ...	2%	2%	2%
Rotifers and eggs ...	5%	7%	10%
Crustaceans ...	—	negligible	negligible
Mud, sand and waste matter ...	5%	6%	7%

It appears from the table that *Gadusia chapra* is a selective plankton feeder as it shows a liking for the Euglenids and Dinoflagellids. Rotifers, Diatoms, microscopic green algae and others were probably supplementary forms consumed with the former types of plankton. Other organisms such as Cladocers and Copepods have been excluded from the food, though they were observed in the plankton samples collected on the same dates as the fish. As a matter of fact, the plankton consisted of a high percentage of Flagellates.

Thanks are due to Sri G. N. Mitra, Director of Industries, Orissa, for his interest.

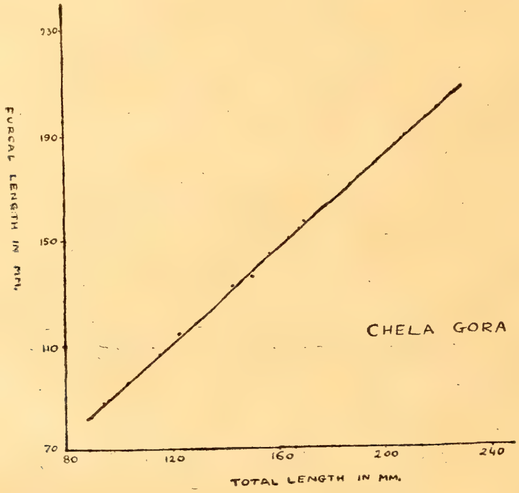
DEPARTMENT OF FISHERIES,
GOVERNMENT OF ORISSA,
CUTTACK,
June 25, 1954.

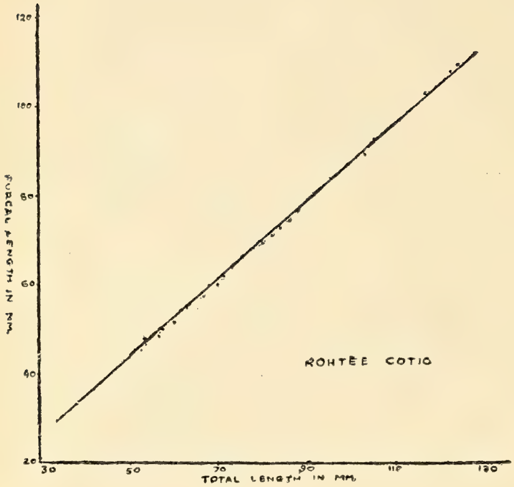
P. MOHAPATRA

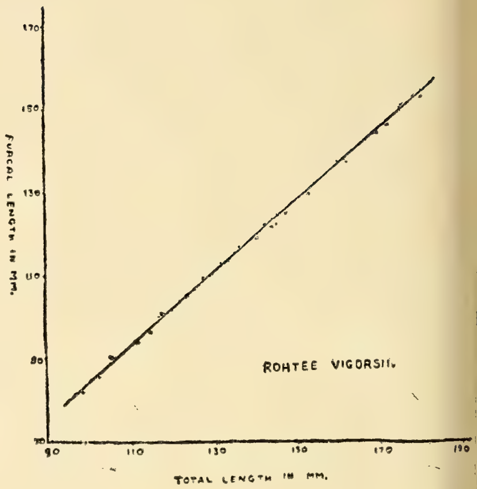
33. THE RELATIONSHIPS OF TOTAL LENGTH TO FURCAL LENGTH FOR FIVE CYPRINIDS

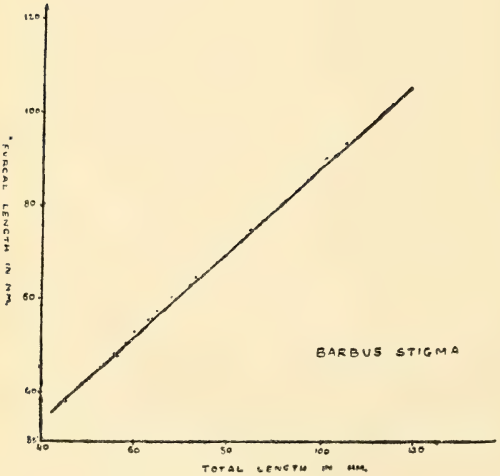
(*With five graphs*)

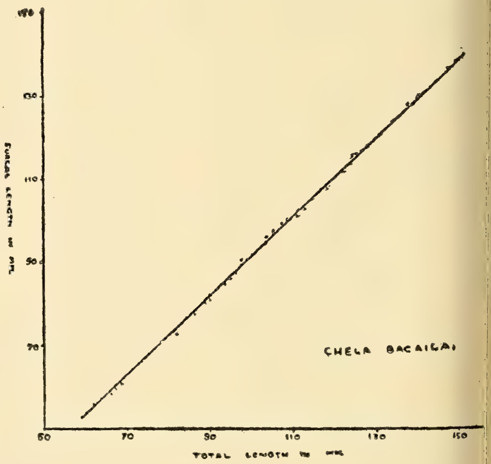
This note deals with the study of the general relationship between the total length and furcal length in the Indian Cyprinids, *Chela bacaila* (Ham.), *Chela gora* (Ham.), *Barbus stigma* (Cuv. & Val.), *Rohtee cotio* (Ham.) and *Rohtee vigorsii* (Sykes). The expression furcal length means the length of the fish between the anterior extremity of the snout and the points where the caudal fin bifurcates. In the above-mentioned varieties the total length can be measured more easily than the furcal length, particularly in the field. But as the total length is often vitiated by wear and tear it is advisable to record both the lengths. The main object here has been to derive appropriate mathematical value, correlating the two variables, total length and furcal length, in a general manner and for calculating one from the other. In view of this, a wide range for each species has been included




120
100
80
60
40
20
FURCAL LENGTH IN MM.
30
50
70
90
110
130
TOTAL LENGTH IN MM.
ROHTEE COTIO


170
150
130
110
90
70
FURCAL LENGTH IN MM.
90
110
130
150
170
190
TOTAL LENGTH IN MM.
ROHTEE VIGORSII.


120
100
80
60
40
35
FURCAL LENGTH IN MM.
40
60
80
100
120
TOTAL LENGTH IN MM.
BARBUS STIGMA


150
130
110
90
70
FURCAL LENGTH IN MM.
50
70
90
110
130
150
TOTAL LENGTH IN MM.
CHELA BACAILA

in the study, and collections from different centres of Orissa were taken. The measurements of the younger stages of these species have not been recorded in this note. It is recognised that a single value of x in the equation $FL = x\,TL$ (where FL stands for furcal length and TL for total length) does not apply for all lengths of fish with uniform accuracy. In the present note, however, average values of x for every size range of about 20 mm. is derived.

In India, length: weight relationships of certain fishes have been worked out, but the inter-relationships between the total length and the furcal length or the standard length of any fish have not been mentioned. Among recent workers, Orcutt (4) and O 'Connel (3) of California in their publication on the life-history of two fishes have derived the relationships between the total length and standard length.

The specimen studied included those from the Government fish farms at Cuttack, Chowdwar, Kausalyaganga, Puri and Kendrapara, during the winters and summers of 1950, 1951 and 1953. The length measurements were made on the fish measuring board divided into millimetres. Fish longer than 90 mm. or 100 mm. were usually measured fresh, while the smaller ones were preserved in 5% formalin in the field and measured in the laboratory. When the two variables total length and furcal length are plotted on a graph paper diagonal straight lines passing through most of the points are obtained for each variety. A graph for each species is given in this note. The values of the factors x mentioned in Table II are derived from these graphs.

Table I gives the sub-families of the family Cyprinidae to which the species belong, the total number of fishes measured and the range of the total length of each species. Table II gives the factor x for each size range, in order to convert one length to the other. The furcal length can be calculated by multiplying the total length with the factor x. The equation is $FL = x\,TL$ (where TL and FL stand for the total and furcal lengths respectively). For example, the furcal length of a specimen of *Chela gora* measuring 140 mm. in total length could be derived from the following, $FL = 0.9224 \times 140$, i.e., 129.136 mm. The same equation may be similarly applied to find out the total length, when the furcal length is known. . . . . It may be noticed that the values of x are maximum for *Chela gora* and minimum for *Rohtee vigorsii*. In *Chela gora* the value of x decreases with the increase in length, while in the other varieties it increases with length.

TABLE 1

Subfamilies and Species	No. of fish	Range of total length
Abramidinae ...		
Chela bacaila (Ham.) ...	137	59 mm.—152 mm.
Chela gora (Ham.) ...	216	88 mm.—229 mm.
Cyprininae ...		
Barbus stigma (Cuv. and Val.) ...	148	41 mm.—119 mm.
Rohtee cotio (Ham.) ...	261	34 mm.—128 mm.
Rohtee vigorsii (Sykes.) ...	96	94 mm.—183 mm.

TABLE II

Species	Size Range	No. of fish	Factor *x*
Chela bacaila ...	59 mm– 80 mm	21	0.8934
	81 mm–100 mm	39	0.8990
	101 mm–120 mm	33	0.9046
	121 mm–140 mm	37	0.9102
	141 mm–152 mm	7	0.9158
Chela gora ...	88 mm–110 mm	20	0.9260
	111 mm–130 mm	52	0.9242
	131 mm–150 mm	67	0.9224
	151 mm–170 mm	28	0.9206
	171 mm–190 mm	15	0.9188
	191 mm–210 mm	29	0.9170
	211 mm–229 mm	5	0.9152
Barbus stigma ...	41 mm– 60 mm	39	0.8620
	61 mm– 80 mm	68	0.8710
	81 mm–100 mm	30	0·8800
	101 mm–119 mm	11	0.8890
Rohtee cotio ...	34 mm– 50 mm	48	0·8585
	51 mm– 70 mm	62	0·8625
	71 mm– 90 mm	96	0·8665
	91 mm–110 mm	43	0·8705
	111 mm–128 mm	12	0·8745
Rohtee vigorsii ...	94 mm–110 mm	13	0·8420
	111 mm–130 mm	10	0·8470
	131 mm–150 mm	38	0·8520
	151 mm–170 mm	28	0·8570
	171 mm–183 mm	7	0·8620

I am indebted to Sri G. N. Mitra, Director of Industries, Orissa, for his kind interest in the general pursuit of work.

DEPARTMENT OF FISHERIES,
CUTTACK-1, P. MOHAPATRA
March 12, 1954.

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34. EFFECT OF JAGGERY ON FISH LIFE[1]

The ecological conditions of South Indian temple tanks are favourable for fish-life. These religious institutional waters serve as sanctuaries where the fish population is protected and allowed to grow and breed[1],[2]. Most of these waters contain a permanent bloom of a blue-green alga like *Microcystis aeruginosa* or *Anabaena flosaque* or *Oscillatoria tenuis*, and yield about 2,000 lb. of fish per acre per year, if suitably stocked with fishes like *Catla catla, Chanos chanos, Cirrhina mrigala, Cyprinus carpio* and species of *Labeo*[3]. But the immemorial religious custom of pilgrims dissolving jaggery as vow in these waters sometimes leads to heavy contamination and consequent large-scale mortality of fish.

FISH MORTALITY IN NAGASUNI TANK

The Nagasuni tank of the Sankaranainar temple in Tirunelveli district has a waterspread of 2,450 sq. yards and an average depth of 10 ft. Its water was once baled out in 1945, and was found on examination in March 1946 to be favourable for fish culture (Table I). The tank was taken over by the Madras Fisheries Department in April 1948 and stocked with 500 fingerlings of *Labeo fimbriatus* and *Cirrhina reba* in November 1948 and with 840 *Etroplus suratensis* in the beginning of February 1949. The growth of these fish was satisfactory, the former two species attaining a size of 10 in. by the end of April 1949. The plankton of the water and the filamentous algal growth on the sides of the tank were rich and varied, and consisted of the following:—

Myxophyceae.—Anabaena, Aphanocapsa, Microcystis, Oscillatoria and *Spirulina*.

Chlorophyceae.—Ankistrodesmus, Chaetophora, Closterium, Crucigenia, Euastrum, Gonatozygon, Oedogonium, Pandorina, Pediastrum, Selenastrum, Spirriogyra and *Staurastrum*.

Bacillarieae.—Mastogloia, Melosira, Nitzschia and *Synedra*.

Protozoa.—Chilomonas, Chlamydomonas, Euglena, Phacus and *Epistylis*.

Rotifera.—Brachionus, Diurella, Philodina and *Salpina*.

Copepoda.—Diaptomus and *Mesocyclops*.

On 12th February 1949, about 100 fish were found floating dead in the tank; and thereafter 10 to 15 fish were found to die and float daily. Towards the end of February 1949, the water in the tank became black in colour and began to stink badly. By April, the colour of the surface water became dark green due to a thick bloom of *Microcystis aeruginosa*, but the bottom layer was almost colourless containing few specimens of the alga. The hydrological conditions of the tank both at the surface and bottom at 11.45 a.m. on 28th April 1949 are given in Table I.

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[1] Communicated with the permission of the Director of Fisheries, Madras.

TABLE I

Showing hydrological conditions in the Nagasuni tank on 21-3-46 and 28-4-49.

21-3-1946		Conditions	28-4-1949	
7-25 a.m.	3-40 p.m.		Surface	Bottom
Green	Green	Colour	Dark green	Colourless
17·5	9·3	Transparency, cm.	5·0	30
27·2	32·0	Temperature °C.	33·8	27·9
7·1	8·9	pH	7·9	7·1
0·83	7·64	Dissolved oxygen, cc/litre ...	0·98	nil
0 56	nil	Free CO_2, p.p. 100,000 ...	0·234	0·796
nil	1·5	Carbonates, p.p. 100,000 ...	nil	nil
13·12	10·7	Bicarbonates, p.p. 100,000 ...	13·35	16·54
6·8	6·8	Chlorides as Cl, p.p. 100,000 ...	18·0	18·0
—	—	Silicates as SiO_2, p.p. 100,000 ...	0·77	0·83
0·006	—	Phosphates as P_2O_5, p.p. 100,000 ...	0·16	0·18
—	—	O_2 absorbed in 30 minutes at 100 °C, p.p. 100,000 ...	5·03	4·73
nil	nil	Nitrates as N, p.p. 100,000 ...	nil	nil

Abnormal or pathological conditions could not be noted in the dead fish. But from the above table it could be seen that the oxygen content of the surface sample was low and that the bottom sample was practically free of oxygen. The low oxygen content was due to the excessive rotting of the alga, which formed a coalesced slimy mass covering almost the entire water surface. There was a pronounced thermal stratification, as indicated by the high difference of 5·9°C. in temperature between the surface and bottom layers. Sulphuretted hydrogen was present in the bottom layer alone. But the water was frequently stirred from top to bottom by thousands of worshippers bathing in the tank; and this mixing of the hydrogen-sulphide containing bottom layer with the surface water would deplete the small amount of oxygen contained in the surface layer and thus bring about fish mortality. The formation of hydrogen-sulphide was due to the decomposition of excessive amount of organic matter under anaerobic conditions at the bottom. The excessive amount of organic matter is to be traced to heavy organic pollution and to throwing into the tank by the worshippers of large quantities of jaggery which is easily decomposed by the common saprophytic bacteria. Every last Friday in a month several devotees assemble to worship the deity and each of them throws into the tank approximately 0.3 lb. of salt and 1 lb. of jaggery. Further, during the Tamil months of *Thai* (January-February) and *Adi* (July-August) more than 50,000 people are reported to assemble in the temple and dissolve large amounts of jaggery in the tank.

Laboratory experiments.—The following are the results of a series of laboratory experiments conducted by us in 1950 to examine the effect of the addition of varying concentrations of jaggery upon fish life.

Experiment I.—Seven earthen pots, containing five litres of water in each, were taken; and in the first six were dissolved one-eighth, half, one, two, five and ten pounds respectively of jaggery so that the resulting solutions were of the strength 1, 5, 10, 20, 50 and 100 per cent jaggery. The seventh pot without any addition of jaggery was kept as control. All the pots were kept open and exposed to sunlight. Six fishes, one each of *Barbus stigma* (3″), *Danio aequipinnatus* (2½″), *Gambusia affinis* (1″), *Ambassis ranga* (1″), *Brachydanio rerio* (1″) and *Oryzias melastigma* (1″) were introduced into each of the pots. In 50% and 100% jaggery solutions all the fish were in distress immediately after release and floated dead in about 15 minutes; and in solutions of lower concentrations also they could not live as shown below.

Percentage of jaggery solution	*No. of hours after which all fish died*
100	0·25
50	0·25
20	21·0
10	45·0
5	45·0
1	192·0
0	No death throughout.

The physico-chemical variables of the solutions in the pots were examined at the beginning of the experiment soon after jaggery was dissolved and fishes were introduced, and are detailed in Table II.

TABLE II

Showing Results of Laboratory Experiment I

	Pot 1	Pot 2	Pot 3	Pot 4	Pot 5	Pot 6	Pot 7
Percentage strength of jaggery solution ...	1·0	5·0	10·0	20·0	50·0	100·0	Control
Temperature, °C ...	32·0	32·0	32·0	32·0	31·4	31·0	32·0
pH ...	6·6	6·4	6·2	6·0	5·9	5·8	6·9
Free CO_2, pp. 100,000 ...	0·90	2·85	4·75	21·85	43·70	66·03	0·35
Carbonates, pp. 100,000 ...	nil	nil	nil	nil	nil	nil	nil
Bicarbonates, pp. 100,000 ...	22·26	—	68·02	102·04	241·2	466·9	15·77
Dissolved oxygen, cc/1 ...	1·82	0·49	nil	nil	nil	nil	4·75

From the table it would be seen that there was a slight reduction in temperature in the case of 50 and 100 per cent solutions; the pH decreased from 6.9 in the control to 5.8 in 100% solution (as the solutions were coloured dark brown, 1 cc. was diluted to 10 cc. with distilled water and the resultant pH alone measured using the indicators Bromo-thymol blue and Cresol red); free CO_2 and bicarbonates increased enormously with increase in jaggery; and dissolved oxygen content decreased from 4.75 cc./litre in the control to 1.82 cc./litre in 1% solution, to 0.49 cc./litre in 5% solution and to *nil* in all the other higher concentrations. Examination of the pots at the end of the experiment revealed that in all of them except the control there was no oxygen left and large amounts of CO_2 had accumulated.

Experiment II.—Experiments were conducted to find out the effect of varying concentrations of jaggery on *Microcystis*—containing tank water (*a*) soon after jaggery was added, (*b*) after 3 hours of exposure in sunlight and (*c*) after keeping for 3 hours in darkness, imitating natural conditions in a tank. Varying amounts of 50% jaggery were added to 500 cc. of tank water and the physico-chemical variables were determined under the above three conditions; and the results are detailed in Table III. There was a general decrease in pH and dissolved oxygen and an increase in free CO_2 and bicarbonates with increase in the amount of added jaggery. Pots exposed to sunlight were less affected by the addition of jaggery than those kept in darkness, in respect of pH free CO_2 and dissolved oxygen. It is evident from this experiment that the effect of the addition of jaggery will be greater at the bottom of tank than at the surface.

DISCUSSION

Jaggery is unrefined sugar produced from sugar-cane and is dissolved by the pilgrims in some temple tanks as a means of discharging their vows to God. Ordinarily when small amounts of the jaggery are added to these tanks, there is an increase in the general biota of the water and the fishes stocked in it are provided with more food. The Nagasuni tank at Sankaranainarkoil was rich in variety and bulk of fish food organisms and recorded good growth of fish. But when jaggery is added in large amounts as on festival days, there is an enormous increase of putrescible organic matter in the water which exerts a heavy oxygen demand. Taylor[4] found that the organic matter in freshwaters consist largely of plant residues in the form of particulate or, more commonly, soluble material, which is resistant to bacterial attack, but that the bacterial activity in lake waters responds to addition of glucose. It is quite probable that the added jaggery may stimulate the oxygen consumption by the rotting algae in the tank. As seen from laboratory experiment II, addition of large amounts of jaggery tends to create at the bottom of the tank anaerobic conditions which favour the decomposition of organic matter and the production of hydrogen sulphide. The latter may reduce the oxygen contained in the upper layers when the tank water is stirred by the pilgrims bathing in it. From the above considerations it will be evident that the addition of large amounts of jaggery is indirectly harmful to fish life and even cause their mortality on some occasions.

TABLE III

Showing Results of Laboratory Experiment II

Variables	Immediately after addition of jaggery solution						After three hours of exposure to sunlight						After three hours storage in darkness					
Amount of 50% jaggery added	0 cc.	1 cc.	2 cc.	5 cc.	10 cc.	20 cc.	0 cc.	1 cc.	2 cc.	5 cc.	10 cc.	20 cc.	0 cc.	1 cc.	2 cc.	5 cc.	10 cc.	20 cc.
Free CO_2 p.p. 100,000 ...	Nil.	0·67	0·94	1·35	1·98	3·15	Nil.	0·49	0·54	1·17	1·80	2·88	Nil.	0·91	1·19	1·44	2·21	3·73
Carbonates „ ...	0·33	Nil.	Nil.	Nil.	Nil.	Nil.	0·66	Nil.	Nil.	Nil.	Nil.	Nil.	0·17	Nil.	Nil.	Nil.	Nil.	Nil.
Bicarbonates	40·96	45·29	48·0	50·62	50·62	61·94	40·63	41·3	42·62	46·60	31·95	58·61	42·5	44·0	46·6	50·62	54·0	61·3
pH	8·3	7·8	7·6	7·4	7·4	7·0	8·5	7·8	7·8	7·6	7·3	7·1	8·3	7·6	7·5	7·4	7·2	7·0
Dissolved Oxygen cc/litre ...	3·14	3·00	2·37	2·09	2·09	0·49	4·19	3·91	3·07	2·51	1·19	0·28	3·07	2·51	2·23	1·68	1·12	0·07

Laboratory experiments have also shown that one per cent concentration of jaggery is sufficient to kill young fishes in about 8 days, the addition of jaggery decreasing the dissolved oxygen and pH and increasing free CO_2 and bicarbonates of the water. Similar chemical effects produced by the cane sugar factory effluents from the Vuyyur factory and their harmfulness to the fish fauna of the Chandriya Kalva in Krishna district have also been noted by us[5,6]. Pytlik[7] has referred to the existence of a directly poisonous substance called *saponin* in sugar wastes. Laboratory experiments done by us proved that even 0.002 per cent solution of saponin will suffice to kill fishes like *Labeo fimbriatus* and *Barbus sarana*, 2 to 3 in. in size.

All these observations make it clear that the addition of jaggery to temple tanks is both directly and indirectly harmful to fish life. But it may be difficult to prevent pilgrims from dissolving jaggery in the tank, as such an act will interfere with religious sentiments. Therefore steps may be taken to harvest the fishery of the tank before the festival periods or not to utilise such waters for pisciculture.

FRESHWATER BIOLOGICAL STATION,
KILPAUK, MADRAS, P. I. CHACKO
June 12, 1954. R. SRINIVASAN

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35. SPAWNING OF ROHU AT POWAI LAKE

I wonder whether anybody can throw light on the following observation:—

Rohu spawned this year during the first heavy downpour period (after the Solar Eclipse) on 30th June. Fish taken on or before 2nd July were all full of roe. The lake level had then risen rapidly as 11 in. of rain had fallen within 48 hours.

On 4th July the level was 1 in. below the overflow. Three Rohu taken by me on that day were entirely empty; blood-red discolouration near the vent and orange spots on gill covers indicated that the fish had spawned. All fish taken thereafter had also finished spawning. Therefore breeding, whether successful or not, must have taken place between 2nd and 4th July. As usual fish immediately after the spawning were quite weak and did not put up a fight for about 10 days. Thereafter they have fully recovered and most of them did the typical Rohu leap, after being hooked.

Now on 10th August I took two Rohu and Mr. D. I. Amore took another Rohu, all between 10 and 12 lb., at about the same place. One fish was in top condition and had fully recovered, whereas the other two were in a miserable condition—completely lean and hollow-bellied. I believe these fish must have finished spawning shortly before. If this presumption is correct then there must be two breeding periods with an interval of about 5 weeks between. Is it likely that these fish which could not reach the monsoon rivulets during the first heavy downpour around 1st July, spawned during the second flood from 29th July to 2nd of August?

Rahimtoola House,
Homji Street, Fort,
Bombay,
August 12, 1954.

F. R. GOLDSCHMIDT

[Dr. Kulkarni, Director of Fisheries, Bombay, comments on the above as follows:

'It is well known that the Rohu and other major carps of India breed under the stimulus of floods in rivers and streams. Observations of Dr. Goldschmidt on Rohu, *Labeo rohita*, probably, therefore, lead to the fact that the fish spawned in the neighbourhood of streams joining the Powai lake during July and August 1954. This year, the heaviest rainfall of 110 in. from June 20 to August 20, as against only 75 in. every year during the entire monsoon period June to October, has accorded the necessary stimulus to spawn. From Goldschmidt's observations it appears that he has come across two instances of probable breeding. His description indicates that fish had spawned, whether successfully or otherwise cannot be stated reliably. It is, however, not right to consider these occasions as two different breeding periods. The carps are known to breed from June to August, the exact period depending on the stage of maturity of gonads of the breeders, the flood condition and the habitat.

Dr. Goldschmidt has incidentally noted solar eclipse time as one of the periods of spawning. This coincides with new moon period. In Bengal, where spawning grounds and periods of these carps are skilfully located by the local fishermen, the common belief prevails that spawning is more rampant if flood and new moon or full moon periods coincide in the aforesaid months. It is not, therefore, surprising if Dr. Goldschmidt also independently and unwittingly came to the same type of observations.'—Eds.]

36. DISTRIBUTION OF *RANA LEITHII* BOULENG. —A CORRECTION

In *JBNHS*, Vol. 42, p. 59 and 46, p. 405, Mr. Charles McCann has referred to a specimen of *Rana leithii* Boulenger, obtained at Gersoppa. We have recently had the opportunity of re-examining this specimen in the Bombay collection and find that it is the very closely allied species *Rana beddomii* Gunther and not *R. leithii*. The former is determined by its larger size and the first finger not being shorter than the second.

Rana leithii occurs along the Western Ghats from Suriamal, Thana District (*ca.* 20°N. lat.) in the north through Kanheri (Bombay), Khandala and the Karla Caves to Panchgani in Satara District, which at present constitutes the southernmost limit of the species. It was nowhere found in such numbers as at Matheran, the type-locality. McCann referred to its abundance there and H.A. also saw large numbers on 18th October 1954. On the last date they were silent and no tadpoles were seen, but large numbers of adults were common on the wet rock cuttings by the railway, on wet rocks in streams flowing into Simpson's Tank, and also in short grass by the side of the same lake.

There was great variation in body colour, some being dark-grey and blackish, others paler and pink, and some with golden patches.

The species is diurnal and often seen on roads by day, many being killed by horses and rickshas and also by the light railway.

Bombay Natural History Society,
114, Apollo Street,
Bombay,
November 1, 1954.

HUMAYUN ABDULALI
J. C. DANIEL

37. EXTENSION OF RANGE OF *RANA TEMPORALIS* GUNTH.

In October 1951 I saw a party of frogs on wet exposed rocks in a small hill stream shaded by bushes at Mahableshwar, 4,500 ft., Satara District, Bombay. My attention was first drawn to them by their calling in chorus, more reminiscent of birds than frogs. When calling two sacs show up one on each side of the throat. More were later seen in the stream at Dhobi's Waterfall which is in well-wooded country.

A specimen collected was identified as *Rana temporalis* Gunth. at the Indian Museum. This marks an appreciable extension of the known range of this species northward along the Ghats. Boulenger in 'Frogs of the Genus *Rana*', (*Rec. Ind. Mus.*, xx, 1920) gives its distribution as 'Malabar and Ceylon'. Annandale in a note in Boulenger's paper (l.c., page 160) says that the species 'is confined chiefly to edges of rock streams at no great altitudes. It sits exposed on flat rocks and stones and leaps, often for a considerable distance into the water when disturbed'. Ferguson (*JBNHS*, xv: 503) in Travancore found it only in the hills at considerable heights, and describes it as of a shy and solitary nature. Wall found it in the Nilgiris at *ca.* 6,000 ft. 'at some dark recess beside a mountain stream', and noted that the call was a subdued, harsh monosyllabic croak. Jerdon (*JASB*, 1853, p. 531) found them in mountain streams in forest only.

Uttangi in 'On Some Ciliate Parasites of Frogs and Tadpoles of Karnatak', Bombay Presidency, (*Rec. Ind. Mus.*, xlix, page 141, 1951) records this as rare in ponds in Dharwar, but since this species appears to be restricted to mountain streams, we cannot be quite sure how far his record is correct. In the hill streams of the district this frog probably does occur.

The tadpole of this species does not appear to have been described.

Faiz & Co.,
75, Abdul Rehman Street,
Bombay 3,
September 24, 1954.

HUMAYUN ABDULALI

[Mr. Abdulali visited Mahableshwar again 31st October to 2nd November 1954 and offers the following additional notes:

'Seen in streams on Fitzgerald Ghat, and in Blue Valley nullah. They were more common at Dhobi's Waterfall where Dinsha Panday reported having seen them in amplexus a week ago. A small pool in the course of the rocky stream held several masses of eggs attached to the bottom or sides, all a few inches below water. One or two frogs sat inside the pool and appeared to be associated with the eggs. There is some variation in the calls, but the commonest starts with a guttural croak (not unlike the call of *Rana tigirina* caught by a snake) followed by a series of *tuk-tuk-tuks*. They call both by day and night, and are quite active during the day.'—Eds.]

38. EXTENSION OF RANGE OF THE FROG *UPERODON GLOBULOSUM* GUNTH.

On June 13, 1954, H.A. visited the Kanheri Caves (*ca.* 1,300 ft.) near Borivli, Salsette Island, Bombay. At the entrance just outside the caves, facing west is a line of rock cisterns. In the first, which contained about 9 in. of water, were two or three large specimens of *Rana tigirina*, a few *R. breviceps* and a number of toadlike, inflated frogs floating sluggishly, flat on their bellies in the corners. One specimen was taken for identification, and on the following day it was discovered that J.C.D. had brought in the identical specimens from the same place, having obtained them an hour or two before or after H.A.!

On the night of June 16, we visited the place together and found the cistern overflowing and only four of these frogs present. They were sluggish in their movements and not easily persuaded to move either on water or on land. Though this frog can jump a couple of inches it normally walks stretching its forelegs forwards, well beyond the head. It was also impossible to turn them on their backs for the shortest moment, as with the use of their limbs, they would right themselves instantaneously.

The following observations were made on a male specimen kept alive: When placed on loose earth it sits quietly for a while, then commences to dig with its hindfeet and lowers its hind quarters into the earth with no movement visible on the surface. In a few spurts it is completely underground, the eyes disappearing last.

It refused to eat earthworms, but devoured white ants when they were immediately under its mouth. They were also flicked off the sides of its face with its tongue. White ants crawling over its face were brushed off with the foreleg. A small frog, *Microhyla ornata*, was placed in the same cage, but remained completely ignored even when quite under it.

The colour of the upper surface is leaden grey, with a brownish tinge. It has a few tiny spots on the fore and hind legs and also along the sides of the belly. These spots look like minute pimples and may be glandular. The underparts are pale colored with tinges of yellow. The skin is perfectly smooth except near the vent, where the females, which are considerably larger than the males, have numerous pustules which may be secondary sexual characters. The male has a dark chin. The gonads of the males dissected were enlarged, while the ovaries of the females were spent.

The pupil is round (*vide* Parker, Monograph of the Microhylidae, p. 75, 1934) and not vertical as stated in the Fauna, 1890. The tiny nostrils often quiver.

On June 13, we took between us 5 ♂♂s and 2 ♀♀s while the four individuals of June 16 were all males as determined by their dark chins. On June 19 only two of these were present in the cistern as also a large number of tadpoles swimming freely near the surface. In the adjoining cistern were more *Uperodon* tadpoles, some with fore and hind legs. Tadpoles of *Rana breviceps* were found in the same cistern but they kept to the vertical stone walls of the cistern down to a depth of about 12 in. The *Uperodon* tadpoles were relatively small in size and olive brown above with a pale tail striped longitudinally with dark blotchy lines. The sides and underparts were white, speckled with dark except in the centre of the belly which was pure white. A more detailed description of these tadpoles is being prepared and will be published separately.

By a strange coincidence, Shamoon Abdulali also obtained *Uperodon* tadpoles in a rain water pool at Thana, sea-level, Salsette, Bombay. The pool, about 18 in. deep, was shaded by a large tree at one end and held a lot of algae. Tadpoles of *Microhyla ornata* were noted in this pool, but they appeared to keep to the shallower and clearer portions only. The pool dried up after a few days and all the tadpoles presumably perished. Subsequent to this no more *Uperodon* adults or tadpoles were found in spite of continued search in the surrounding area, and it is strange that three persons should independently have found this hitherto rare species within the Bombay area practically all within the same short period. The previous records are from Russelkonda, Ganjam District, Andhra, Bengal and Berar whence adults were taken.

S. D. Mukerji (*JASB*, xxvii, 1931, pp. 97-100) records a specimen 47 mm. in length obtained in Calcutta. He refers to slimy secretion appearing on the body especially the dorsum when the animal was subjected to open air and light for a considerable length of time. His specimen, however, refused to take any of the ants and termites offered to it and died after 390 days of fasting.

Thurston, Superintendent of Government Central Museum, Madras (Catalogue of Batrachia, Salientia and Apoda of South India, 1888, p. 43) records that the specimen from Russelkonda had its stomach enormously distended by a mass of winged white ants.

Dr. J. L. Bhaduri, who kindly confirmed the identity of this species, obtained specimens of the frog from termite mounds in Bengal and has already recorded (*JBNHS*, Vol. 45, pp. 251-254) some of the habits noted above.

The measurements of five of the specimens taken by us are as follows:—

Sex	♂	♂	♂	♀	♀
Tip of snout to vent	64	64	65	71·5	84 mm.
Breadth of head...	17·5	17	17	18·5	21
Eye	4	4	4·5	4·5	5
Upper eyelid	2·5	2·5	2 7	3·7	3
Inter orbital width	8	8·5	8	10	10·5
Inter metatarsal tubercle	7·1	7	7	9	9·5
Outer metatarsal tubercle	3	3·5	3·5	4	4·7
Tibia	20·5	20	20·5	25·5	25·5

Bombay Natural History Society,
114, Apollo Street,
Bombay,
September 25, 1954.

HUMAYUN ABDULALI
J. C. DANIEL

39. FOOD OF THE BULL-FROG (*RANA TIGIRINA*)

Mr. T. Gay's note in Vol. 52 (1): 212 on the food of the bull-frog reminds me of a similar murderous onslaught, as he puts it.

I had a pet squirrel which was not then fully grown. I had just put her down on the ground and let her follow me when from behind the row of flower pots a frog leaped out and was on her in a flash. The squirrel let out a frightened squeak and struggled to free herself but the marauder's grip was tough. In a panic I took up three or four stones and hit the frog hard, but he was in no mood to let go. Fortunately I spied a stick nearby, took it up and frantically beat the frog with it till he let go his arms and jumped back behind the flower pots. I took up the squirrel which lay limp in my cupped palm with her heart throbbing fast. She recovered within an hour and I was glad to note that there was neither a broken limb nor a single bruise on her person.

Sunny View,
Saharanpur,
July 31, 1954.

(MRS.) ARUNA BANERJI

40. DISTRIBUTION AND HABITS OF THE BATRACHIAN, *ICHTHYOPHIS GLUTINOSUS* LINN.

In view of the paucity of records of this curious worm-like batrachian in India, it may be worthwhile noting that in the forenoon of 23rd October, 1953, I saw one on a path to one of the 'points' on the Kanara side of the Gersoppa Falls in south Bombay State. The soil was hard laterite and the animal progressed by a series of ripples reminiscent of a millipede rather than a snake or eel. When put in a box its sticky surface enabled it to climb smooth vertical surfaces. In life the coloring was bright metallic—with a bright yellow stripe along the sides, quite unlike specimens which have been in a preservative for some time. It measured 196 mm. in length.

c/o Faiz & Co.,
75, Abdul Rehman Street,
Bombay,
August 20, 1954.

HUMAYUN ABDULALI

[Some years ago, Mr. A. F. Hutton sent some live specimens to the Society from the Nilgiri-Wynaad and which in turn were presented to the Victoria Gardens in Bombay. Other specimens in the Society's collection are from Anaimalai Hills and Ootacamund in South India and from Garo Hills in Assam. Mullan (*JBNHS*, 33: 723) records one found by Fr. Blatter at Panchgani, 4,300 ft., Satara District, Bombay. Mr. C. McCann who recorded the species *I. monochrous* from Khandala (*JBNHS*, 31: 1039) stated that 'It lives under stones, during the rains, in burrows much after the fashion of the earthworm which it also resembles in its movements. At first sight it might well be mistaken for one of these creatures as its body is also coated with slime. On the removal of the stone under which it lives the animal soon begins to descend into its burrow away from light'.—Eds.]

41. A NOTE ON THE COURTSHIP IN THE SAND CRAB [*PHILYRA SCABRIUSCULA* (FABRICIUS)]

'Courtship' of an elementary type is observed in *P. scabriuscula* which inhabit the low tide zone of Waltair and Visakhapatnam coast in large numbers.

The courtship commences by the third week of November and lasts till about the end of January. At the height of the season a number of *P. scabriuscula* were observed in pairs each consisting of a male and a female. Most of the females were ovigerous with ripe orange-coloured eggs. In the laboratory the actual courting and copulation were observed for the first time on 25-11-1952. Subsequently this process was repeatedly observed. The male caught hold of the female from the dorsal side by hooking its first pair of ambulatory legs on to the chelipeds and the first pair of walking legs of the female, and thereby getting a firm hold on her; in this position the two remaining motionless for a period which ranged from a few minutes to two hours. When the female straightened her abdomen from its usual tucked-in position, the male with great rapidity formed an arc round the female and still holding her in the same fashion, faced his partner. The two crabs were seen very close to each other just for a few seconds and the male then released the female.

When they are thus close together the sperms from the male are transferred into the genital opening of the female. This is evident from the fact that the anterior part of the sternal groove of the male is exposed during and immediately after sperm transference. When the two crabs separate, the abdomen of neither is in the tucked-in position. The *receptaculum seminalis* when dissected immediately after copulation contained sperms proving they were actually transferred.

Throughout this process the female is passive. If the female does not relax her abdomen the male faces her and forces her to release the abdomen from the tucked-in position.

P. scabriuscula appears to be peace-loving, for during a period of five years of frequent observation of this widely distributed species the author has not seen more than three instances of fights and this amongst males only. In every case, it was during the breeding season and for a mate. A fight for the seizure of food never occurred. One typical instance of the fight was when a male was attempting to seize a female for mating, and another male approached them. The first male immediately hooked the chelipeds and the first pair of walking legs of the female with its first pair of ambulatory legs paralysing her movements. In this state, he puts up a defensive fight with his chelae, using one of them for catching the wrist of one of the chelae of the opponent thereby disabling the latter from approaching the female already in his possession. This struggle between them lasted for quite a long time (not less than five minutes) during which period the female was not released at all. It was the intruding male that finally fled.

The second instance was almost similar to the above, while in the third case the intruder was much stronger and during the struggle the female escaped. The above instances are not common for, in general, a male with a female remains undisturbed.

DEPARTMENT OF ZOOLOGY,
ANDHRA UNIVERSITY,
WALTAIR,
August 8, 1954.

(MISS) K. G. RAJA BAI NAIDU

42. SEX RATIO AND VARIABILITY OF APODOUS SEGMENTS IN *APUS* (*PHYLLOPODA: CRUSTACEA*)

(Published with the kind permission of the Director, Zoological Survey of India)

Males are generally known to be rare in *Apus*. This certainly appears to be the case in *Apus cancriformis*. Gurney, (1925) however, pointed out that in *A. orientalis* (which he referred to as *A. asiaticus*) males outnumbered the females in the collection that he examined. The author (Tiwari, 1952) also reached the same conclusion after examining a number of freshly collected examples of this species from Panchgani in the Bombay State. Recently Main (1953) has stated that in *A. australiensis* males are more abundant than are usually believed to be in *Apus*. He also pointed out the large variability in the number of apodous segments, a character that is greatly relied upon in the taxonomy of *Apus*.

In order to investigate whether males really outnumber the females in *A. orientalis*, and to examine the variability in the number of apodous segments, the author requested Mr. Humayun Abdulali to lend him the collection of this species preserved in the Bombay Natural History Society. A fine sample of 76 examples of this species was thus obtained, and the present note contains a result of the examination of this and other samples of *A. orientalis* and *A. cancriformis* present in the Zoological Survey of India.

SEX RATIO IN *A. orientalis* AND *A. cancriformis*

The number of males and females was ascertained from the following samples.

Apus orientalis

1. Panchgani, 74 specimens; Coll. Humayun Abdulali, 29-7-53, (Bombay Nat. Hist. Soc. coll.)
2. do , 6 specimens; Coll. E. Blatter, Date ? (Regd. No. C1527/1, Z.S.I.)
3. do , 16 specimens; Coll. S. L. Hora, Sept. 1924 : (Regd. No. C1264/1, Z.S.I.)
4. do , 13 specimens; (greenish variety); Coll. ?, 13th August, 1950. (Z.S.I.)
5. do , 11 specimens; (reddish variety) 13th August, 1950. (Z.S.I.)

Apus cancriformis

1. Jammu State, Kashmir, 30 specimens; Coll. Pandit Ram Dhan, Donor A. J. Grove, Esqr., Date ? (Z.S.I.).
2. Banihal Ilaka, south of the Pir Panjal Range, alt. 6,000 ft. 13 specimens, Donor ?, Date ? (Z.S.I.).
3. Same locality, 5 specimens; (Z.S.I.).
4. Shrinagar, 8 specimens; Coll. T. B. Fletcher, 6-7-1923. (Z.S.I.)
5. Gandarbal, Kashmir—paddy fields 8 miles from town, alt. 7,000 ft., 24 specimens; Coll. Kashmir Survey; 25-6-1921 (Regd. No. C1262/1, Z.S.I.).
6. Loc. etc. ? 21 specimens (Z.S.I.).

Thus, 120 examples of *A. orientalis* and 101 of *A. cancriformis* were examined. The following table gives the number of males and females of each species present in each sample.

TABLE I

A. orientalis				*A. cancriformis*			
Sample No.	Number of Males	Females	Total	Sample No.	Number of Males	Females	Total
1	18	56	74	1	0	30	30
2	3	3	6	2	0	13	13
3	9	7	16	3	0	5	5
4	11	2	13	4	3	5	8
5	10	1	11	5	0	24	24
				6	0	21	21
	51	69	120		3	98	101

The above table reveals that whereas males do seem to be rare in *A. cancriformis*, they certainly are abundant in the Panchgani species. Taken samplewise, the first sample containing the largest number of individuals has the males and females roughly in the ratio of 1 to 3, a figure somewhat approximating to that given by Main for *A. australiensis*. In the other samples, however, the number of males is disproportionately higher. As the samples do not appear to be random no statistical inference can be derived from them beyond the fact that males are quite abundant in this species.

It was, however, noticed that the males were much larger in size than females, and in samples where males outnumbered the females the individuals were large-sized. Measurements of the median length of the carapace (measured between the median notch in the sulcus and the transverse groove behind the eyes) in a number of individuals yielded the following results:—

TABLE II

Size range in millimeters	Frequency		
	Males	Females	
5·0—6·9	0	11	11
7·0—8·9	7	29	36
9·0—10·9	13	12	25
11·0—12·9	14	6	20
13·0—14·9	4	0	4
	38	58	96

It is thus obvious that in the above material the males attained a larger size in comparison to females, and this probably may explain the apparent preponderance of males over females in some samples where the individuals are large in size. It is to be noted that Gurney's sample also contained more males than females, and more detailed investigations are necessary before the exact nature of the marked fluctuations of the sex-ratio in this species could be ascertained.

Work on the biology of this species by some conveniently placed naturalists will be welcome to determine (i) the sex-ratio in *A. orientalis*, (ii) whether there is any seasonal fluctuation in the number of males and females in the population of this species, and (iii) if males and females differ from each other in size and other characters. If any disparity in the sex-ratio of the populations of this species really exists, it will be worthwhile to investigate whether this is due to genetic factors or due to environmental causes like differential death rate, etc. The occurrence of parthenogenesis and existence of polyploid individuals as the causes of unequal sex-ratio can also not be ruled out.

VARIABILITY OF APODOUS SEGMENTS

The value of meristic characters in taxonomic studies has been well recognised. In *Apus* where reliable diagnostic features are few, the number of apodous segments is generally depended upon for taxonomic purposes (Barnard, 1931; Tiwari, 1952). As will be apparent from Main's statistics of *A. australiensis* this feature is rather variable in the Australian form. In the Indian species the number of apodous segments is fairly constant and can be safely relied upon as a criterion for delimiting species.

An examination of 103 examples of *A. orientalis* and 99 specimens of *A. cancriformis* gives the following frequency distribution for the apodous segments.

TABLE III

Apus orientalis

No. of apodous segments	Frequency in Males	Frequency in Females	Total
11	0	47	47
12	4	16	20
13	33	0	33
14	3	0	3
	40	63	103

Apus cancriformis

No. of apodous segments	Frequency in Males	Frequency in Females	Total
6	0	47	47
7	3	49	52
	3	96	99

Females, thus, have 11-12 apodous segments and males have 12-14 in *A. orientalis*, while in *A. cancriformis* the apodous segments are either 6 or 7 in number. This number agrees with the figures given by Gurney, except that the range for females will be 11-13, the last figure being rather rare. In *A. mavliensis* where males are not known at present the apodous segments in females vary from 8 to 10 although the last number occurs most frequently. It can, therefore, be concluded that for Indian species the number of apodous segments is a reliable taxonomic character in the present state of our knowledge of this genus.

ZOOLOGICAL SURVEY
OF INDIA,
CALCUTTA.

KRISHNA KANT TIWARI

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Barnard, K. H. (1931): *Ann. S. Afr. Mus.*, **39**: 241.
Gurney, R. (1925): *Rec. Indian Mus.*, **27**: 439-442.
Main, A. (1953): *West Austr. Nat.*, **4**: 34-39.
Tiwari, K. K. (1952): *Rec. Indian Mus.*, **49**: 197-206.

43. OCCURRENCE OF THE MANTIS *GONGYLUS GONGYLOIDES* LINN. IN JUNAGADH (SAURASHTRA)

Gongylus gongyloides Linn. belongs to the phylum Arthropoda, to the sub-class Orthroptera of the class Insecta and to the family Mantidae. In 1877 this insect was recorded in the Midnapur District of Bengal by Dr. Anderson (*Proc. Asiat. Soc. of Bengal*, 1877, p. 193) and was shown to the members of the Asiatic Society of Bengal.

A single solitary specimen of *Gongylus gongyloides* Linn. was first observed in the Bahauddin College compound in the month of October 1953. It was kept in the laboratory in the living state for three to four days, but unfortunately it was attacked and killed by red ants. It was preserved as a dry specimen in the College Museum.

So far as the author is aware this insect forms the first record of the species from Junagadh in Saurashtra.

BAHAUDDIN COLLEGE,
JUNAGADH, I. H. KACHHI
February 25, 1954.

44. ON SOME UNRECORDED HOST PLANTS OF THE LAC INSECT, *LACCIFER LACCA* (KERR), (HOMOPTERA: LACCIFERIDAE)

Watt[1] (1901) published the first comprehensive list of host plants of the common Indian lac insect, *Laccifer* (=*Tachardia*) *lacca* (Kerr) and enumerated 56 species occurring in India, Burma and Ceylon. In 1910, Stebbing[2] increased this number to 88, and as our knowledge of the subject advanced further additions were made by several workers so that at present well over hundred species of host plants are known.

The following notes on three species of hitherto unrecorded host plants of *L. lacca* are based on my observations made in Chota Nagpur while I was working as Entomologist at the Indian Lac Research Institute, Namkum. Specific identifications of the lac insects were made at the Zoological Survey of India, Calcutta, during the course of a systematic study of the family Lacciferidae, and I am grateful to Dr. S. L. Hora, Director of the Survey, for providing facilities for the same. Names of two of the plants were supplied by Sri K. S. Srinivasan of the Botanical Survey of India, Calcutta, to whom my thanks are due for his help.

It will be noted that all the three species of plants dealt with here are of exotic origin and have been growing in the country as avenue and garden trees for sometime past. In the lists of host plants given by Watt, Stebbing and others fair numbers of exotic plants were included. That exotic species could be important from the point of lac production is indicated by the fact that in Thailand the Rain Tree [*Samanea* (*Pithecolobium*) *saman* Merrill], a native of tropical South America, is a major source of Thai lac which is coming up fast in competition with the Indian lac in foreign markets.

1. *Acacia auriculiformis* A. Cunn. (Leguminosae: Mimosaceae).

Lac incrustations were observed on a number of branches of a solitary tree in a private garden compound at Ranchi, in October, 1952. Thin branches of nearly half an inch diameter were covered with thick incrustations some of which were easily six inches long. The resinous secretion was thick and light amber in colour; wax filaments were also relatively long and suggested a healthy state of the lac insects embedded in the incrustations. The females were full of developing eggs and the swarming of larvae took place by the end of October. The strain concerned was apparently *rangeeni*.

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[1] Watt, G. (1901): *Tachardia* (*Carteria*) *lacca*, Kerr. Lac (lakh) and the lac industries. *Agric. Ledger* (Ent. Ser. No. 9), Calcutta, pp. 181-347+i-ix.

[2] Stebbing, E. P. (1910): A note on the lac insect (*Tachardia lacca*), its life-history, propagation and collection. *Indian For. Mem.* (*For. Zool. Ser.*), **1** (3): 33-114 (1-82).

The infection seemed to have been brought about either by accident or through the agency of birds which may carry nymphs on their bodies from one tree to another. It was generally believed that this tree easily succumbs to the attack of the lac insect in the course of a few seasons if the infection is not destroyed in time.

A. auriculiformis is a native of Northern Australia and Queensland and is cultivated in several parts of India. Isolated trees occur in private garden compounds at Ranchi.

2. *Peltophorum ferrugineum* Benth. (Leguminosae: Mimosaceae).

Nearly a score of trees of this species were observed to carry lac at Jamshedpur in June, 1952. The lac infection varied from rather scattered cells on thick branches ($\frac{3}{4}$ inch diameter) to thick and continuous incrustations on relatively thinner branches ($\frac{1}{3}$-$\frac{1}{2}$ inch diameter). There were no incrustations near the tips of branches as most of the larval settlements seem to have died prematurely. The scattered cells, referred to above, were almost spherical while the cells constituting the incrustations were a little longer along the vertical axes than along the horizontal. The quantity and colour of the resin secreted compared favourably with that generally obtained from a palas (*Butea monosperma* Kuntze) tree. There being two broods in a year, the swarming of lac larvae took place once in July and then in October. The trees were being self-infected as the contractor who had obtained the right to collect lac from these and other trees such as the Rain Tree, the peepal (*Ficus religiosa*), the siris (*Albizzia lebbek* Benth.), growing along the avenues, obviously took care to leave intact a sufficient number of branches bearing mature lac to serve as a source of infection for the next brood. Owing apparently to the constant strain of infection and frequent lopping, the trees showed signs of deterioration.

P. ferrugineum is a native of the Eastern Peninsula and Ceylon and is frequently planted in several parts of India. In Chota Nagpur it is often planted along the roads in several towns.

3. *Jacaranda mimosifolia* D. Don. (Bignoniaceae) (Syn. *J. ovalifolia* R. Br.).

One tree of this species was carrying the lac infection at Jamshedpur. The incrustations were sparse to moderately thick but in most other respects it was similar to that described above for *P. ferrugineum*. The infection of lac appeared to have spread to this species from a nearby hedge of *Inga dulcis* Willd. which was carrying lac. At the time of my visit in June 1952 many infected branches had been cut down in order to save the tree. Subsequently a tree in the author's compound at Ranchi was also successfully infected.

Mahdihassan[3] (1936) was able to rear *Laccifer* (=*Lakshadia*) *communis* (Mahd.) by artificial infection on this species at Bangalore.

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[3] Mahdihassan, S. (1936): The range of host selection and specific differentiation of lac and other parasites. *Arch. Naturgesch.* N.F., **5**: 1-22.

A native of Brazil and of somewhat recent introduction in India, the trees *J. mimosifolia* may be seen in private and public gardens.

ZOOLOGICAL SURVEY OF INDIA,
34, CHITTARANJAN AVENUE,
CALCUTTA-12,
June 25, 1954.

A. P. KAPUR
M.SC., Ph.D. (Lond.), D.I.C.

45. PRESUMPTIVE FATAL STING OF THE COMMON HOUSE WASP, *POLISTES HEBRAEUS*

Here in Dehra Dun, on July 17, 1954, at 16.05, I.S.T., a lady aged 63 years was stung by a yellow house wasp, *Polistes hebraeus*, between the 3rd and the 4th toe of her right foot. She became very restless and complained of breathlessness. Medical aid was promptly summoned. On arrival, at about 16.17 the doctor gave the lady an injection of Adrenalin. She expired almost immediately—only 12 minutes after being stung.

It is a fact that the lady was unusually sensitive to wasp sting. On previous occasions when stung by a wasp she used to feel a great deal of pain all over her body and also complained of a choking sensation. She was slightly asthmatic—an injection of Adrenalin, however, used to give her prompt relief.

This case appears to be unique as no one here seems to have heard of a similar one.

16, RAJPUR ROAD,
DEHRA DUN, U.P.,
August 2, 1954.

J. N. ONIAL,
P.F.S. (Retd.)

46. SOME INSECTS ATTRACTED TO LIGHT

The following insect species were taken at light in Bangalore from 20th October to 5th November 1953. They were caught inside a study room into which they entered through an eastern window (4 ft. × 2 ft.), 5½ ft. above the ground level, and overhung by an electric light (25 *W*, 50 *C*, 220 *V*, 5 *A*), the illuminated filament being visible from outside. The wide range of species obtained is of considerable interest, when the visual stimulus in insects is known to be complex and the form and magnitude of the response variable from species to species with the location and the intensity of illumination, length of exposure period, degree of light or dark adaptation, time of day, and temperature (Dethier, 1953). Of the 90 species collected, as many as 33 are of economic importance, and these are indicated by an asterisk. No comprehensive list of insect species attracted to light appears to be available in the Indian literature, although Lefroy (1909), Dina Nath (1923) and Ayyar and Anantanarayanan (1934) recorded certain common examples along with the principal families whose members showed positive phototropism; light-traps have, however, been a favourite experiment with economic entomologists for the control of some major crop pests (Ayyar and Anantanarayanan, 1934; Ballard, 1923; Dina Nath, 1923; John, 1947; and Putta Rudraiah, 1945-46).

Meteorological Data.—Hours of catches: 7 to 11.30 p.m.

20th to 31st October: Temperature range 65.5°F. to 84.2°F. with an average of 73.5°F., night temperature normal to below normal; mainly cloudy weather, with intermittent rain, slight to 1.72 inches. Wind velocity 2.0 to 3.6 m.p.h., direction WSW., SSW. and NNW. A great majority of the insects were taken during this period.

1st to 5th November: Temperature range 55.1°F. to 81.1°F. with an average of 69.3°F., night temperature below normal; weather fair to dry. Wind velocity 2.5 to 3.7 m.p.h., direction, N., NNE. and NE.

Acknowledgments.—I am grateful to Dr. M. Putta Rudraiah, Government Entomologist, Bangalore, for facilities and encouragement. I am also highly indebted to the Director, Commonwealth Institute of Entomology, London, for kind courtesy in determining most of the insect species.

List of Insects

ORTHOPTERA

Gryllidae.

Pteronemobius csikii Bol.

DERMAPTERA

Forficulidae.

Diplatys sp.[1]

ISOPTERA

Kalotermitidae.

**Neotermes assmuthi* (Holmgren).

HEMIPTERA

Coreidae.

Liorhyssus rubicundus Sign.

Lygaeidae.

Eucosmetus sp. and *Metochus uniguttatus* Thunbg.

Nabidae.

**Nabis capsiformis* Germ.

Miridae.

Licocoris sp. and *Trigonotylus dohertyi* Dist.

Delphacidae.

Perkinsiella faseialis Dist. and *P. insignis* Dist.

Jassidae.

Euscelis indicus Dist., **Nephotettix apicalis* Motsch. and **N. bipunatatus* Fabr.

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[1] A new species, since described as Diplatys *excidens* Hincks—*Prcc. Roy. ent. Soc.*, Ser. B, *23*, (9-10): 161.

LEPIDOPTERA

Pyralidae.

Ancylolomia sp., **Antigastra catalaunalis* Dup., *Bostra* sp., *Canthelea lateritalis* Walk., **Chilo zonellus* Swinh., **Cnaphalocrocis medinalis* Guen., *Epipagis cancellalis* Zell., **Glyphodes bivitralis* Guen., **Hymenia recurvalis* Fab., *Nephopteryx* sp., *Nymphula diminutalis* Snell., *N. stagnalis* Zell., *Psara licarsisalis* Walk., *Pristarthria minutella* Rag., **Pycnarmon cribrata* Fab., **Pyralis manihotalis* Guen., **Raphimetopus ablutella* Zell., **Schoenobius bipunctifer* Walk., *Synciera traducalis* Zell., and *Udea martialis* Guen.

Bombycidae. *Trilocha varians* Walk.

Geometridae.

**Anisephyra ocularis* Fab., *Scopula idearia* Swinh., **S. octuaria* Walk., and *Sterrha lineata* Hmps.

Syntomidae. **Syntomis passalis* Fab.

Lymantriidae. **Laelia litura* Walk.

Arctiidae. **Amsacta lineola* Fab., *Celama taenista* Snell., *Siccia guttulosana* Walk., **Utetheisa pulchella* Linn.

Agrotidae (Noctuidae).

Antarchaea mansueta Walk., **Anticarsia irrorata* Fab. **Cosmophila flava* Fab., *Dichromia orosia* Cram., *Eublemma anachoresis* Wllgrn., **Euxoa spinifera* Hb., *Hydrillodes morosa* Butl., *Hypena strigata* Fab., **Mocis frugalis* Fab., *Nodaria cornicalis* Fab., *Ozarba hemiphaea* Hmps., *Ozarba* sp., *Perigea serva* Walk., **Polytela gloriosae* Fab., *Prodenia litura* Fab., *Proxenus melanospila* Guen., *Rhynchina pervulgaris* Swinh., *Rivula biocularis* Moore, **Sesamia inferens* Walk. and **Spodoptera mauritia* Bsd.

COLEOPTERA

Carabidae. *Colpodes ruficeps* Maol.

Staphylinidae. *Zyras bicolor* spp. and *Z. indorum* Fauv.

Anobiidae (Ptinidae). **Lasioderma sericorne* F.

Elateridae. *Cardiophorus formosus* Curtis.

Tenebrionidae. *Curimosphena fasciculatus* Fa.

Scarabaeidae. **Heliocopris bucephalis* Fab., * *Oryctes rhinoceros* Lin. and *Phyllognathus dionysius* Fab.

Aphodiidae. *Aphodius carinulatus* Motsch.

HYMENOPTERA

Braconidae. *Heterogamus* sp. and **Microbracon hebetor* Say.

Ichneumonidae. *Cremastus* spp., **Enicospilus* sp., and *Netelia* sp.

Eulophidae. **Tetrastichus* sp.

DIPTERA

Psychodidae. *Psychoda alternata* Say and *Telmatoscopus albipunctatus* Will.

Culicidae. *Chaoborus* sp.

Chironomidae. *Pentaneura* sp. and *Polypedilum* sp.
Sciaridae. *Sciara* sp.
Muscidae. **Atherigona* sp. (possibly *oryzae* Mall.)

DIVISION OF ENTOMOLOGY,
DEPARTMENT OF AGRICULTURE, S. USMAN
BANGALORE-1.

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47. LEECHES

Referring to Mr. Smythies's interesting note[1] on leeches, while not professing to be an expert on them, by many years of close contact (*sic*) with them in my vocation as a planter, I have been forced to observe these revolting creatures and their ways, and my observations may be useful to add to his.

I do not know how many species there are but have noted what appear to be many, some mottled, some striped and large, some small and black; these latter seem to be far the most painful as I have always found that when one can feel the stinging bite, one may be sure to find a small black one at work, whereas the larger ones are not noticed until one feels the wet sticky blood trickling down after they have dropped off. I have seen a very large pale coloured one on cattle. I presume that they are entirely dependent on blood for sustenance as their mouth parts are not designed for any other form of food. There are many warm-blooded mammals in the jungle for them—I have found them on snakes, but even then many must go hungry though in common with snakes, they too can go for long periods without food and it would be interesting to know how long a gorged leech takes to digest its load of blood. In the Anaimalai Hills I have found them throughout the dry weather along stream edges under heavy coffee shade and mulch. Many must die when they drop off their temporary hosts on to unsuitable ground and the blood inside them congeals in the hot sun before they can reach moist cover. A leech must have coolth and moisture to live.

It is well known how soon they appear again at the first rains after the dry period. Like earthworms, leeches carry their eggs in a larger segment of the body; when is this shed releasing the eggs, during or after the dry weather? I believe leeches are both bi-sexual and hermaphroditic.

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[1] *JBNHS*, 51 (4) : 954.

Mr. Smythies asks how high a leech can climb. While I do not believe in the parachutist leech, I have brushed them off low branches of trees at head level where I have noticed them sitting in the relaxed position at the extremities of the leaves, both in Assam and South India. I have seen them crawl up boles of trees to about four feet.

It takes some time for the leech to determine the direction of its next meal. This is evident in the manner in which it first extends itself from its contracted resting position and bends the upper part of its body towards the direction of the person and waves it about to and fro until it gets, wind of its meal, then off it sets full tilt looping towards it falling over sometimes in its haste. Again this is demonstrated when two or more persons are walking in single file, the first person will find comparatively few on him but those following will be covered. This all goes to show that they scent their 'prey' through olfactory means. I have noted on a close and careful watch that the mouth or sucker is widely open during the osculations of the leech's body prior to its march towards one. I have found the maximum distance at which they first notice one to be about 2½ yards.

Mr. Smythies mentions that leeches require complete freedom from fire to maintain existence. This is not borne out in the case of clearing jungle for tea plantations, etc., when the brush is fired and the clearing then planted up. As soon as a cover is obtained over the ground in two to three years leeches may again be found.

The danger from leech bites is of course the intense irritation set up at the site, and infection introduced from scratching. Is an irritant injected by the leech as in the case of the mosquito?

It is a fact that land leeches are not to be found in Africa at any rate in West Africa which I know. I have walked through cold dripping evergreen rain-forest in the hills of the Cameroons, which if it had been in the Nilgiris would have been crawling with them. However, they are compensated for by the presence of other noxious insects such as the Tsetse Fly, Chrysops, sandflies in millions, mosquitoes and soldier ants. Not all Indians are familiar with the leech. Familiarity breeds contempt, and I remember what delight tea pluckers used to show when a 'new girl' from the plains saw her first leech and ran shrieking with fright from it!

As regards protective clothing, a pair of linen stockings under woollen ones does the trick. I am not in favour of completely covering one's limbs with clothing as one spends more time than one can afford searching in the upper regions of one's clothing for them. They are bound to find a way in somewhere if not down one's neck. I prefer to let them have their fill round my knees by wearing shorts, at any rate one can pick them off there easily enough, and from where they can drop off easily when gorged.

1, Cromwell House,
Crook Log, Bexleyheath,
Kent, England,
April 12, 1954.

R. N. CHAMPION-JONES

48. LAND LEECHES

The following notes to Mr. Smythies' query about leeches may be of interest. I have never seen a leech drop from a tree. I have seen them in clusters of five or six on the underside of a single leaf between two and four feet from the ground waiting for their victims. As a man or animal passes he is apt to brush up against them when they fasten on to the clothing or body. They certainly do not rely on touch to be aware of their prey, but use some other sense. If you put your hand near a cluster on a leaf they will all stretch themselves out towards you. I cannot remember at what distance but, I think, your hand would have to be only a few inches away.

Prevention: Putties soaked in tobacco juice. The leech crawls into the folds of the putties and there is turned into rubber. Besides two pairs of thin socks a good plan we used for a stroll in the garden in Gangtok was to wear white socks and tuck white tennis trousers into them. In this way you or someone else could usually see a leech before he started work.

Treatment: Our Medical Officer, Dr. Dyer, gave me a very useful tip for dealing with a leech once he had got hold. First of all get him off with a pinch of salt but don't pull him off; then, to staunch the blood burn a piece of cotton wool the size of a golf ball, put a spot of iodine on the wound and put the cotton ash on. Pull up your sock or take some steps to keep the ash in place for a few minutes. The ash makes a kind of artificial scab which can be removed in your next bath.

I speak with some experience. I was once attacked in the Assam forests when in low condition and every bite festered. I bear the scars today. One night I took 150 (mostly those turned to rubber) off my clothes and one leg, it then got dark and I could not count the other leg!

Why do leeches not attack barking deer and other wild inhabitants of the jungle?

STIFFKEY,
NORFOLK,
March 25, 1954.

F. M. BAILEY,
Lt.-Col.

49. LAND LEECHES

I was most interested in Miscellaneous Note No. 18 on Land Leeches by Mr. B. E. Smythies in Vol. 51, No. 4 of the *Journal*.

I have had 30 years experience of leech infested jungles in the South Indian hill ranges, including the Malanaad of Coorg and Mysore, the Nilgiris and Nilgiri-Wynaad, the Nelliampathi and Anamallai Hills, and the High Wavy Mountains in the Madurai District.

Many of the questions posed by Mr. Smythies have intrigued me. The following are some additional observations:—

Some 20 years ago, in the Anamallais, I did some small experiments on leeches with the help of our estate doctor. We dissected some, as far as we were able to do so with limited facilities, with the object of finding out what they ate. In none of our specimens did we find anything but humus and leaf mould. At the same time we tried a number of experiments in test tubes to try and find out what common reagents were lethal to them.

The result of these experiments was most interesting. Any acid reagent had little or no effect on them, in fact they appeared to survive quite happily in contact with quite strong solutions of hydrochloric acid.

On the other hand they reacted very quickly to anything alkaline. A small spot of free lime was quite sufficient to kill a leech very quickly. Very dilute caustic soda was equally lethal. Such things as tobacco decoctions, and coarse soap emulsions, were also very effective in killing leeches besides acting as repellents.

The killing power of alkalis was what I expected to find. The effectiveness of coarse soap is probably due to the residue of soda ash in the soap, as the better the soap the less effective it is. In our jungles soils are generally of high acidity, derived either from the high humus cover in heavy rain forest, or from the laterite of more open forest, and it was logical to expect that leeches would be happy living in an acid medium. I also tried malariol on them which seemed to have little or no effect.

Ever since these experiments I have used coarse soap rubbed into ankle puttees as a protective. It is the finest protective I know. It will remain effective on 6 in. monsoon days, and stand up to occasional crossing of streams. If it is well rubbed into the puttees the rain keeps a constant dribble of soapy water flowing over the boots for a considerable period. Protection is almost complete in the worst leech jungle.

Many planters in South India use a leech proof stocking of fine woven cotton which is good until the leech climbs over the top. Silk stockings or socks also seem to defeat their efforts at penetration.

A curious fact about leeches is that elephant, bison, sambar, Nilgiri Thar, wild dogs, panther and tiger live quite happily in sholas and forest which are so leech infested that the local jungle races will not enter them in the monsoon. I have shot many wild animals in such forest, and none of them have ever shown signs of having been worried by leeches. On the other hand tame dogs, cats, horses and domestic cattle will all be attacked freely and viciously. Domestic cattle—particularly those with English blood—will suffer severely in condition if they graze continuously in leech-infested areas. I feel sure that wild animals living in these jungles would be unable to live there if they did not have some natural protection. It is a fact that *Bos gaurus* is the only ox which is known to sweat. My guess is that the natural protection of all wild animals living in leech-infested jungles is an alkaline skin secretion.

I agree with Mr. Smythies that I have never seen a leech climb a tree, and I have never had a leech drop on me from a tree. In very bad jungle they can be picked up off undergrowth shrubs, but even so they are rarely above knee height. From that height they may easily escape notice until they have worked up to the back of the neck.

It is a well-known fact that in bad jungle it pays to walk first in the column, and that those following always collect more leeches than those in front. I suspect that the leeches feel vibrations—probably heart pulsations—and start moving as soon as they do so. When I was a young assistant we used to have leech races on the club billiard table. The owners put their leeches at one end and then pricked their fingers and held them against the cushion at the other end. Most of the leeches would finish the course without trouble and surprisingly quickly.

As far as South India is concerned it is not true that heavy burns destroy the leech population.

I saw a good deal of the Anaimalai jungle felled and opened in tea. It was magnificent evergreen ironwood rain forest at from 3,000-4,000 ft. elevation—often from 100-120 ft. high. The system then was to fell the jungle in August, and put a fire into it in January. A good burn—which meant a very fierce burn—was desired, and it was often impossible to walk over the burnt area for four or five days after the burn. In spite of this very fierce burn, many areas of tea in the Anaimalais are still infested with leeches. It is possible that they may have re-invaded the cleared areas from swamps and unfelled jungle on the boundaries, but the fact remains that in many places they are still plentiful under the tea and in short grazing grass.

In the grass hills above the Anaimalais—between the Anaimalais and the High Range—at elevations from 6-8,000 ft., leeches are common in the short open tussocky, grass land, most of which is burnt every dry weather and has probably never been under heavy forest. They can be a nuisance when fishing for trout in the Kornelar river and can be picked up there even in the middle of the dry weather. Incidentally a sure way of making leeches drop off is to stand or wade in running water.

It is very curious that leeches are entirely absent from all the sholas and grass land on the top of the Nilgiri Plateau. The sholas would appear to be ideal for them. The elevation, undergrowth, rainfall, and acidity of the soil do not differ in any obvious respect from that of the High Range and the Anaimalais grass hills where they abound. Leeches are found below, and on the edges of the plateau, and there is no obvious reason why they should not have colonised the plateau land.

I have tried sifting the top soil under heavy rain forest in the dry weather, and have never found any traces of adult leeches. Within a matter of 48 hours after the fall of the first really heavy shower they will appear in thousands—many of them apparently fully grown.

I agree with Mr. Smythies that leech bites do not usually go septic unless one is run down. They may cause annoyance by refusing to stop bleeding for quite long periods, and they nearly always irritate if they are on a small blood vessel and not a relatively large one. In bad leech jungle loss of blood may be considerable but once one has overcome repulsiveness they do not worry one unduly.

What happens to a leech after it is fully gorged with a blood meal, and why they should want a blood meal at all, are unexplained mysteries. Their normal function would seem to be aeration and movement of the soil similar to that of earthworms.

TEA ESTATES INDIA LTD.,
POST BOX NO. 13,
COIMBATORE,
March 15, 1954.

J. L. H. WILLIAMS

50. LAND LEECHES

In answer to a few of the queries asked by Mr. Bertram E. Smythies in Vol. 51, No. 4 of the *Journal*, I have consulted my notes taken during 1944 and 1945 while working near the Ledo Road, in Upper Burma.

The maximum number of bites on my person on any one day was 29 in late August 1944, at Tingkak Sakan; the most feeding leeches removed at any one time from me was 9, in early May 1945, at Loglei. In general the vast majority of bites were just above the shoe tops or in the popliteal fossa. I recall being bitten only twice above the belt and these both were in the axilla.

I remember one particular bite on a man working with me, September 1944, at Warazup. It was inside the mouth on the cheek; fortunately the leech was small and easily removed by common salt. This man was a pipesmoker, who put his pipe down anywhere, and I have always assumed that the leech was carried into his mouth on the pipe stem. Normally leeches avoid nicotine, so there may well be a better explanation of this bite.

The soldiers usually removed leeches by heating their anterior end with a lighted cigarette. The leech would attempt to move away from the heat and the soldier would flick it off. The insect repellent issued by the army worked well, but most of the men objected to its texture and to the slime that the leech invariably produced when doused.

As I recall leeches fed all day long in rainy weather but were generally most active in the morning. On rainless days, leeches usually stopped hunting at about 9:30 or 10:00 a.m. Since I was usually in camp after dark, I do not have the time when they start to feed, but men on night duty reported that they were bitten soon after dark. Leeches seemed to me to avoid direct sunlight.

One June morning, while hunting for coecilians, near Shingbwiyang, I collected 37 leeches in about an hour. They were most of them just under the first layer of leaves on the forest floor. I have looked for leeches in a number of places during the dry season without success. Neither did I find them after a January rainy spell in the teak forests east of Bhamo.

I do not recall seeing leeches much higher than about three or four feet off the ground, but at that level they were quite common. This may be because, in that region the underbrush was not very tall. It appeared to me that leeches tended toward the periphery of plants at their maximum diameter. You would often see them bowed upward and outward along the leaf margins.

From my experience I am inclined to be very sceptical of the rain-of-leeches stories. It is quite probable that leeches have fallen upon their prey, but I have not seen it. If a leech fell from any distance I am certain that it would bounce or roll off its target before getting a tail-hold.

Leeches, while 'perched' on leaf margins, are ideal subjects for tropistic experiments. If the hands are held on either side of a leech while so perched, it will invariably turn to the nearer hand except when there is a breeze; then it will turn to the windward hand. If the windward hand is withdrawn and the leeward hand approached, the leech will turn to the leeward hand when the distance ratio is roughly 1:4. I repeated these tests some twenty times and several of the soldiers did them for amusement as well; the results were uniform. There may be an illumination factor in target selection, but without careful control a guess is as much as I dare make.

I feel certain that leeches locate their prey by a chemical sense of some kind. The two hand tests and the distances over which they locate their prey—distances, unfortunately, that I have no record of—leave little room for question. Temperature as such I think may be ruled out as the source of attraction by the distance over which it acts. Radiations of any type would hardly give a 1:4 ratio in a light breeze. Moisture as the attractant may be ruled out by the humidity of their microclimate. Sound waves do not fit the pattern of the two hand experiment. A chemical perception of some kind is to me the only permissible explanation of this phase of leech behaviour.

ARABIAN AMERICA OIL CO.,
DHAHRAN, SAUDI ARABIA, R. S. MATHEWS
April 25, 1954.

51. 'NWE-SHIN' OR 'LIVE CREEPER'

Reference your Miscellaneous Notes in Vol. 52, No. 1, 'Hunter's Sugar' by W. S. Thom, he ended with a para about '*Nwe-Shin*' or live creeper. His version of this creeper with mobile powers which give rise to its local name 'live creeper' sounds rather a 'tall' story. I have indeed come across the 'Nwe-Shin' in streams (prewar) in the Namme Reserve of Mong Mit Division in the Northern Shan States and (last year) in the Indawgyi Reserve in the Myitkyina Division of North Burma. This creature (Phylum Annelida), for I am sure it belongs to the animal kingdom, is as he describes like 'a piece of smooth green coloured creeper' but nothing like as thick as an ordinary pencil. Those I came across were about $\frac{1}{8}$ in. thick and from ten to eighteen inches long. They wriggled rather feebly in the slack water of the stream, and when enclosed in a bottle of water overnight died (I put it down to aspyxiation). Some were observed on land in a partially dried state and when put into the water came to life again. They certainly resemble the aerial roots of a certain creeper that dangle from the leaf-canopy overhead in dense forest, but I have yet to see such a creeper, when cut and thrown into water, come to life and swim off like a live snake!

BURMA FOREST SCHOOL,
MAYMYO (BURMA), H. G. HUNDLEY
August 23, 1954.

52. IDENTITY AND TAXONOMICAL STATUS OF *SESAMUM EKAMBARAMII* NAIDU

In a recent issue of the *Journal of the Bombay Natural History Society,* (Vol. 51—1953) Naidu has described a new species of *Sesamum*—*Sesamum ekambaramii* Naidu, reported to be occurring in the vicinity of Stuartpuram near Bapatla, Andhra State.

On scrutinising the botanical diagnosis, the photograph and the drawings published of this species, as also on examining a specimen of this species kindly sent to us by Mr. Naidu, there seems to be little doubt that this material is identical with *Sesamum alatum* Thonn. (Thiselton-Dyer, 1906) occurring in tropical Africa.

S. alatum was obtained in this laboratory in 1948 through the kind courtesy of Dr. J. A. Martin of the University of South Carolina, U.S.A., and it has been since maintained here. The chromosome number of this species was reported from this laboratory by Kedharnath (1950) to be $n=13$. The plants belonging to our material of *S. alatum* closely conform to the description of *S. ekambaramii* Naidu as also to the mounted specimen of the latter species—the lower leaves of this plant are characteristically palmately-compound and 5- 3- partite, the upper leaves simple; the capsules more than one inch long, with acuminate beak, wide in the upper part, narrow towards the base; and the seeds black, with an apical and a basal wing.

As the morphological characters of both the species are identical, it does not seem possible to accord a separate specific status to *Sesamum ekambaramii* Naidu which must therefore be considered as a synonym of the earlier and validly-described species, *Sesamum alatum* Thonn., as shown below:—

Sesamum alatum Thonn. in Schumach. et Thonn., *Beskriv. Guin. Plant.,* Copenhagen, (1827), p. 284.

Syn. *Sesamum ekambaramii* Naidu in *Journ. Bombay Nat. Hist. Soc.,* (1953), 51: 697:98.

In India, only three species of *Sesamum,* viz. *S. orientale* which is cultivated, and *S. prostratum* Retz. and *S. laciniatum* Klein which are wild, have so far been reported (Hooker, 1885). If the report by Naidu on the occurrence *in the wild state* of *S. alatum* Thonn. (syn. *S. ekambaramii* Naidu) is confirmed, it would constitute the first record of the occurrence of *S. alatum* in this country. Apparently, *S. alatum* Thonn. (syn. *S. ekambaramii* Naidu) has reached India from tropical Africa either as a direct or indirect introduction. It would be interesting to investigate how this tropical African species reached the eastern coast of India.

Our thanks are due to our colleague, Dr. D. Chatterjee, for helpful suggestions.

Division of Botany,
Indian Agricultural
Research Institute,
New Delhi,
January 28, 1954.

S. RAMANUJAM
A. B. JOSHI

53. THE GENUS *MURDANNIA* IN BOMBAY STATE

After the publication of the Critical Notes on this genus in this *Journal* (Vol. 52, pp. 137-141), I have been requested to publish this note on the nomenclature of all the species of *Murdannia* in Bombay State. Here is the list of all the Bombay species with the correct nomenclature and proper references:

Old Name	Correct Name
Aneilema scapiflorum Wt.	*Murdannia scapiflorum* Royle, Illust Bot. Him. 403. t. 95, 1839.
A. herbaceum Wall.	*M. elatum* (Vahl) Bueck. in Engl. & Prantl, Pfam. 15 A : 173, 1930.
A. spiratum R. Br.	*M. spiratum* (L.) Bueck., loc. cit.
A. dimorphum Dalz.	*M. dimorphum* (Dalz.) Bueck., loc. cit.
A. pauciflorum Wt.	*M. pauciflorum* (Wt.) Bueck., loc. cit.
A. versicolor Dalz.	*M. versicolor* (Dalz.) Bueck., loc. cit.
A. nudiflorum R. Br.	*M. nudiflorum* (L.) Santapau, in Rec. Bot. Surv. Ind. 16 : 325, 1953.
A. sinicum Lindl.	*M. sinicum* (Lindl.) Bueck., loc. cit.
A. giganteum R. Br.	*M. giganteum* (Vahl.) Bueck., loc. cit.
A. ochraceum Dalz.	*M. ochraceum* (Dalz.) Bueck., loc. cit.
A. lanuginosum Wall.	*M. lanuginosum* (Wall.) Bueck. loc. cit.
A. paniculatum Wall.	*M. semiteres* (Dalz.) Santapau, in Poona Agric. Coll. Mag. 41 (4): 284, 1951
A. vaginatum K. Br.	*M. vaginatum* (L.) Bueck., loc. cit.

ST. XAVIER'S COLLEGE,
FORT, BOMBAY.

H. SANTAPAU, S.J.

54. THE GENUS *MURDANNIA* IN BOMBAY—FURTHER CORRECTIONS

Recently I sent a note adjusting the nomenclature of the species of Bombay plants hitherto placed under *Aneilema*. On further investigation I find that another correction is necessary.

Murdannia malabaricum (Linn.) Santapau, comb. nov.
Tradescantia malabarica Linn., Sp. Pl. (ed. 2) 412, 1762.
Commelina nudiflora Linn., Mant. 177, 1767 (non Linn. 1753, nomen validum).
Aneilema nudiflorum R. Br., Prod. 271, 1810.
Aneilema malabarica Merr. in *Philip. Journ. Sci.* 7: 232, 1912.
Murdannia nudiflorum Santapau in *Rec. Bot. Surv. Ind.* 16 (1): 325, 1953.

ST. XAVIER'S COLLEGE,
FORT, BOMBAY 1,
August 14, 1954.

H. SANTAPAU, S.J.

55. SOME RECENTLY INTRODUCED OR NEWLY RECORDED PLANTS FROM PATNA DISTRICT AND ITS NEIGHBOURHOOD

Patna is situated on the southern bank of the Ganges, almost in the centre of the Indo-Gangetic plain. In the absence of any hills, the hot and strong summer winds from the west, the monsoons from the south-east and south-west, and in particular the cyclones, jointly help in bringing innumerable seeds from long distances. The Ganges, the Poonpoon, and the Sone rivers, coming from the west, south-west, and south-east respectively, overflow the low-lying lands every year, and also fill up the pools, ponds and ditches. In the years of high floods, a greater part of the district gets submerged. The rivers bring with them seeds and propagating materials of innumerable plants and spread them.

On the north bank of the Ganges lies the Muzaffarpur district. This is inundated every year by the Gandak which comes from the Nepal Himalayas. The incessant traffic of boats and steamers from one bank to the other serves to bring the new introductions from the north to Patna. Patna is approached from other directions by railways and roads. On these there is a fairly heavy traffic of trains, buses, cars and bullock-carts. These bring not only men, but food-grains, spices, etc. from other provinces, even from other countries, and, along with these, the seeds of innumerable weeds. Some of these find their way to the soil, grow, and spread.

Thus Patna is in a favourable position to get new introductions of pan-tropical and even temperate region weeds through the agency of winds, rivers, and man. It also gets many exotic species introduced. Some of such introduced plants are indicated below. These plants have apparently not been recorded by any of the previous workers on the flora of this province (Prain, Woodhouse, Haines, or Mooney) from any part, and as such they appear to be interesting recent introductions. As many of them are widely distributed weeds, their occurrences in this area are not altogether unexpected.

The author is very grateful to Dr. D. Chatterji, Systematic Botanist, Indian Agricultural Research Institue, New Delhi, for going through the manuscript and for suggesting some improvements.

Agyneia bacciformis A. Juss. (Euphorbiaceae); *Alternanthera pungens* H.B.K. (Amaranthaceae); *Amphilophis odorata* A. Camus (Gramineae); *Asystasia gangetica* T. Anders. (Acanthaceae); *Convolvulus microphyllus* Sieb var. *boisseri* Boiss. (Convolvulaceae); *Euphorbia helioscopia* Linn. (Euphorbiaceae); *Heleochloa schoenoides* (L.) Host. (Gramineae); *Homalocenchrus hexandrus* O. Kuntze (Gramineae); *Justicia royeniana* Clarke (Acanthaceae); *Lagascea mollis* Cav. (Compositae); *Lolium perenne* Linn. (Gramineae); *Lolium temulentum* Linn. (Gramineae); *Neptunia oleracea* Lour. (Mimosaceae); *Oxalis latifolia* (H. B. & K.) Calder (Oxalidaceae); *Paspalum vaginatum* Sw. (Gramineae); *Pennisetum ciliar* (L.) Link. (Gramineae); *Phalaris minor* Retz. (Gramineae); *Pseudoraphis aspera* (Koen) Pilger

(Gramineae); *Rauwolffia canescens* Linn. (Apocynaceae); *Scirpus quinquefarius* Buch.-Ham. (Cyperaceae); *Sclerostachya fusca* A. Camus (Gramineae); *Senebiera pinnatifida* DC. (Cruciferae); *Sesbania cannabina* Pers. (Papilionaceae); *Sisymbrium orientale*. Linn. (Cruciferae); *Staurogyne glauca* O. Kuntze (Acanthaceae) *Syndrella nodiflora* Gaertn. (Compositae); *Trichodesma amplexicaule* (DC.) Sedgwick (Boraginaceae); *Veronica anagallis* Linn. (Scrophulariaceae); *Veronica agrestis* Linn. (Scrophulariaceae); *Vicia sativa* Linn. var. *angustifolia* Grahm. (Papilionaceae).

SCIENCE COLLEGE,
PATNA, BIHAR, J. G. SRIVASTAVA
May 25, 1954.

56. A NOTE ON *VENTILAGO GAMBLEI* MERRILL

Dr. E. D. Merrill in an article entitled 'Miscellaneous Malaysian Notes' which has just appeared in the April 1954 issue of the Journal of the Arnold Arboretum has proposed a new name for a common 'Vine', *Ventilago lanceolata* Gamble (*Kew Bull.* 1916: 134), which is found on the Western Ghats, in Malabar and Tinnevelly and also occurs in Ceylon. He says that since Gamble's name has already been used by him (Merrill) for an entirely different Philippine species one year earlier in 1915 [*Philipp. Journ. Sc., Bot.* 10 (1915) 40] a new name is necessary for this species of Southern India and Ceylon.

Merrill writes [*Journ. Arnold Arb.* 35 (1954) 142] as follows:—

'*Ventilago gamblei* nom. nov.

Ventilago lanceolata Gamble, *Kew Bull.* 1916: 134. 1916; Alston in Trimen Hand-book Fl. Ceyl. Suppl. 49. 1931, non Merr. (1915)

A new name is needed for this species of Southern India and Ceylon, as the one selected by Gamble in 1916 had been used by me for a different Philippine species one year earlier.'

Unfortunately, however, Merrill has overlooked the fact that in 1953 K. Suessenguth while monographing the family *Rhamnaceae* for the Pflanzenfamilien had already detected this error and had proposed this very new name, viz., *Ventilago gamblei* Suessenguth (Pflanzenfamilien Band 20 d (1953) p. 152), for *Ventilago lanceolata* Gamble.

The South Indian and Ceylon species hitherto known as *Ventilago lanceolata* Gamble should therefore now be called *Ventilago gamblei* Suessenguth.

FOREST RESEARCH INSTITUTE,
DEHRA DUN. M. B. RAIZADA

57. NEW PLANT RECORDS FOR BOMBAY

(*With two plates*)

In the course of our work in the study of the Flora of the Krishnagiri National Park, Borivli, we have come across several new records, that we wish to bring to the notice of the public. The two plants given in this paper have not been mentioned in any of the standard works on the plants of Bombay, from John Graham to T. Cooke.

a. **Ipomoea triloba** Linn.

This plant is reported as very common in Malaya and other Far East countries, growing in grasslands, hedges, thickets, etc. In Borivli we have observed the plant growing wild on a hedge along the road; however, it is neither common nor abundant in our locality. Phylogenetically this plant occupies a position between *Ipomoea pileata* Roxb. and *I. batatas* Lamk. In general appearance it more closely resembles the latter species.

In the identification of the species we have been helped by Dr. S. K. Mukerjee of Calcutta and Mr. M. B. Raizada, F.N.I., to whom we wish to extend our sincere thanks.

Ipomoea triloba Linn. Sp. Pl. 161, 1753; Ooststroom in Blumea 3: 509, 1940 & Flor. Males. 4 (4): 468, f. 41, 1953.

Convolvulus dentatus Blanco, Fl. Filip., Ed. 1, 89, 1837 (non Vahl, 1794, sec. Merrill).

Ipomoea blancoi Choisy in DC. Prodr. 9: 389, 1845.

An annual, herbaceous *twiner*; *stems* 1-3 m. long, branched, terete, glabrous or sparsely hairy especially at the nodes. *Leaves* simple, alternate, petiolate; petioles 3-8 cm. long; lamina broadly ovate to orbicular, cordate at the base with a shallow, wide sinus, more or less entire or distinctly 3-lobed at the base, the basal lobes rounded or angular; apex acute or apiculate; the whole lamina glabrous 3-8 × 2-7 cm. *Flowers* in 1-6-flowered axillary cymes; peduncles more or less quadrangular, 2-6 cm. long, glabrous, minutely verrucose towards the apex, elongating and thickening in fruit; pedicels 7-10 mm. long, verrucose, elongating and thickening in fruit; bracts triangular-lanceolate, shortly acuminate, caducous, 2-3 mm. long. *Calyx* tubular-campanulate; lobes 5, shortly connate at the base, unequal, the outer ones somewhat shorter than the inner, 6-8 mm. long in flower, enlarging and spreading in fruit; outer sepals elliptic-lanceolate, shortly acuminate or with a reflexed mucro, pubescent with long white hairs on the outer surface, ciliate on the margins; inner sepals broader, elliptic-oblong, mucronate, glabrous or nearly so. *Corolla* rose-purple in colour, often with a deeper centre, infundibuliform, 1-1.5 cm. in diameter; tube 0.8-1.4 cm. long, glabrous; lobes 5, short, obtuse, mucronulate. *Stamens* 5, epipetalous, inserted near the base of the corolla tube, included; filaments hairy at the base only. *Ovary* hairy; stigma 2-lobed, lobes globose. *Capsule* globose, apiculate with the remains of the style, hispid with long, whitish hairs, 5-6 mm. in diameter. *Seeds* 2 or 4, ridged on the inner and rounded on the outer face, glabrous, brownish-black in colour, 3-3.5 mm. long.

Occurrence.—This plant is neither common nor abundant; it has been found growing on a hedge near the office of the Park. Flowers open only in the early morning. In Blatter herbarium we have seen other specimens from Bombay and Salsette Islands; the occurrence of this plant in Bombay is well established.

Flowers and Fruits. October to March.

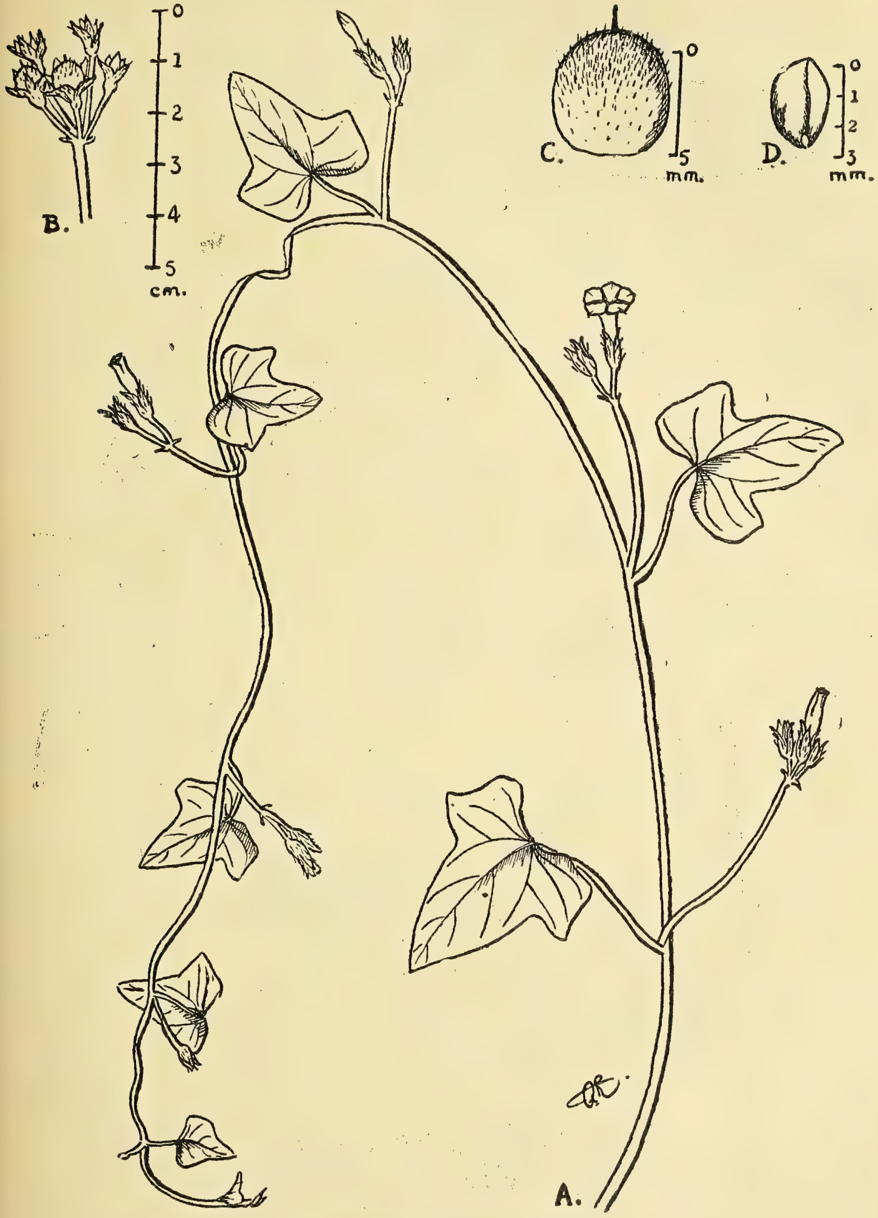
Herbarium specimens examined; Blatter 14558, Victoria Gardens, March 1917; *Acland* 777, Matunga on the railway line, Nov. 1924; *Acland* 1440 & 1442, Matunga, Nov. 1926; *Santapau* 138-40, Jogeshwari, 14 October 1941; *Randeria* 431, Borivili, 7 October 1952; *Randeria* 507, 17 December 1952.

b. **Commelina suffruticosa** Blume

This is another plant, of which there is no mention in the *Flora of the Presidency of Bombay* by T. Cooke; the plant has not been mentioned as occurring in Bombay State by previous botanists. We have examined the specimens in Blatter Herbarium and found that some sheets of this plant have been mixed up with *Commelina obliqua* Buch.-Ham. The two plants are rather similiar, but differ in the following particulars: *C. suffruticosa* has 2-celled capsules, the other's are 3-celled; in the present species the seeds are not appendaged, nor are they adnate to the cell. The flowers in *suffruticosa* are smaller than in *obliqua*; flowering is much earlier in *suffruticosa* than in *obliqua*. *Commelina suffruticosa* shoots out of the ground soon after the first showers of the monsoon, from an underground perennial rootstock; the flowers are open only at about noon; the vegetative parts of the plant keep growing for a long time after the monsoon, in fact as long as the ground remains moist.

Commelina suffruticosa Blume, Enum. 3, 1827; Clarke, Comm. Cyrt. Beng. 12; Fl. Brit. Ind. 6: 374.

A *herb*, 28-50 cm. high; rootstock perennial, bearing a few stout roots on the lower side and 2-3 radical aerial shoots on the upper side; *stem* more or less pubescent or glabrous. *Leaves* cauline, the highest as well as the lowest often reduced to sheaths, distant below, crowded above, sessile or subsessile; sheaths hirsute on the margins, close when young, up to 2.5 cm. long, at length opening by rupturing; lamina of the leaf lanceolate to elliptic, subacuminate, unequal-sided, dark green above and rough, greyish or whitish and smooth below, more or less pubescent or glabrous, hairs caducous, margins scabrid, 9-17 × 3.5-7 cm., the lower leaves often smaller, ovate, obtuse. *Inflorescence* enclosed in spathes, which are terminal or axillary in the upper axils; spathes pedunculate, broadly dimidiately ovate turbinate, apex acute, base truncate or rounded or subcordate, margins hirsute, 1.5-2.5 × 0.9-1.5 cm., with or without mucilage; the peduncles are as long as the leaf-sheaths, in the axil of which the peduncle is borne. The inflorescence is an unbranched, uniparous cyme, one cyme in each spathe, included, 7-flowered. Individual flowers pedicelled, bisexual, hypogynous, zygomorphic and white in colour;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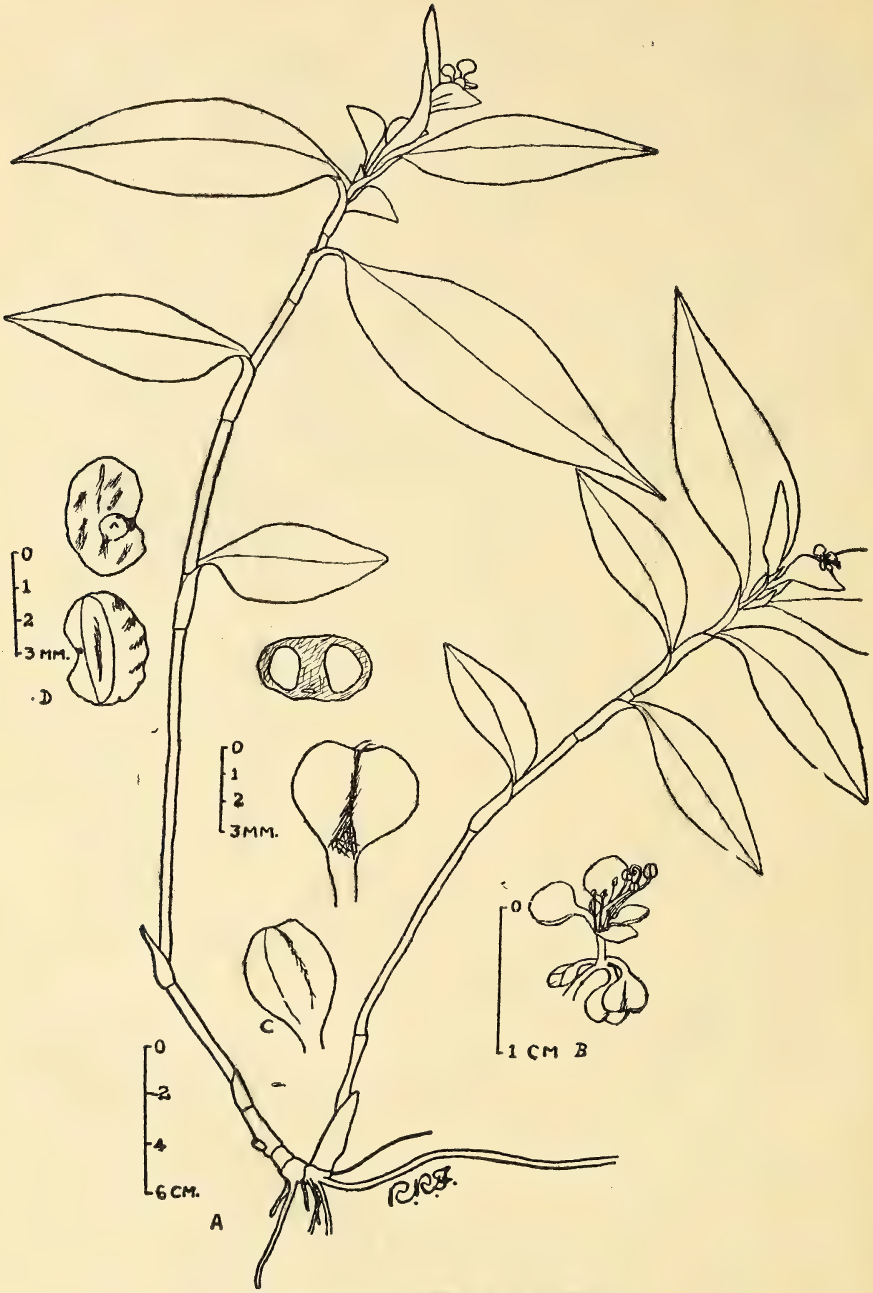
Ipomoea triloba Linn.

A. Branch showing inflorescence and flowers.
B. Fruiting peduncle.
C. Capsule.
D. Seed from the inner surface.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R.R.F.

Commelina suffruticosa Blume

A. Entire plant, showing habit.
B. Inflorescence with spathe removed.
C. Fruit in T.S., in front and side views.
D. Seed, back and side views.

pedicels incurved in bud, erect in flower, recurved in fruit. *Calyx* of 3 sepals; sepals subequal, somewhat hooded, the 2 outer ones obovate to oblong, laterally connate, 3-nerved, 3 × 1.75 mm., the inner sepal keeled, 4 mm. long. *Corolla* of 3 petals; petals subequal, clawed, with an orbicular slightly hooded limb, alternating with the sepals, the 2 larger posterior ones 5 mm. long, the other smaller, 3 mm. long. *Stamens* 3 fertile, 3 sterile; the anthers of the fertile stamens are subequal, one slightly larger than the other two, 8 and 5 mm. long respectively; filaments beardless, those of the fertile stamens stouter and longer than the sterile ones. *Ovary* ovoid, 2-celled, cells 1-ovuled; ovules oblong, flattened, completely filling the cavity. *Fruit* capsular, obcordate, laterally flattened, 2-celled, cells 1-seeded; dehiscing by loculicidal dehiscence, 5 mm. long, about as broad, 2.6 mm. thick; seed filling the loculus, the inner face of the seed flat, the outer one convex.

Occurrence: Common in the undergrowth of forest on higher ground at Borivili, very abundant.

Flowers: From the middle of June to the end of July. *Fruits*: June to October.

Herbarium specimens examined: *Santapau* 6861, Andheri; *Fernandes* 708, 853-854, 1455, 1847-1850, Borivili to Kanheri Caves.

ST. XAVIER'S COLLEGE,
FORT, BOMBAY,
August 31, 1954.

R. FERNANDES, B.SC.
A. RANDERIA, B.SC.
H. SANTAPAU, S.J.

58. E. J. WOODHOUSE—HIS CONTRIBUTION TO OUR KNOWLEDGE OF THE FLORA OF BIHAR

Edward John Woodhouse (1884-1917), B.A., F.L.S., Economic Botanist to the Government of Bengal, and later, to the Government of Bihar and Orissa, the first Principal of the Bihar College of Agriculture, was the first person who intensively studied the flora of Bihar and set up a herbarium here.

Woodhouse collected at Sabour and in its neighbourhood, upto Maharajpur in the east and Bangaon in the north. He visited many other places, both inside and outside the province. He built up a large collection of books chiefly floras for the college and an extensive botanical garden.

After he went away to join the army and his subsequent death, the collection work was carried on by his colleagues till 1921. In 1925, half of this collection was given away to the Ravenshaw College, Cuttack, and half to the P. W. Medical College, Patna, from where it came to this College in 1941.

Though Woodhouse's collections lay at Sabour upto 1925, H. H. Haines, the author of 'Botany of Bihar and Orissa' (1921-1925) makes no mention of them. Since a list of these collections has not been published and since duplicate copies of his herbarium are not kept in any of the recognized herbaria of the world, it was thought worth while to announce the presence of the collections here.

The interesting features of the collection are given below:—

Total no. of herbarium sheets or sets of sheets 3,556.
Total no. of species collected, both wild and cultivated 2,200.
Total no. of sheets acquired from Bombay 1,050.

Of the 73 plants reported by Haines as being doubtfully known or only expected to occur in Bihar and Orissa, 19 had already been collected by Woodhouse from the Bihar area (list 1).

Of the 163 plants recorded by Haines from the Orissa area only, 6 had already been collected by Woodhouse from the Bihar area (list 2).

Of the 87 plants reported by Haines as being very rare, or not being common, or not reported from the northern area (Indo-Gangetic plains of Bihar) 14 had already been collected by Woodhouse from this area (list 3).

21 plants which have been collected by Woodhouse from within Bihar and are not reported in Haines. They form new records (list 4).

6 plants which have been collected from within Bihar and are not reported in Haines. They also form new records if they were not cultivated (list 5).

16 plants which are not listed in Haines. They form new records if they have been collected within this area and are not cultivated (list 6).

LIST 1

Bergia ammanioides, Malachra capitata, Croton sparsiflorous, Sesbania paludosa, Sesbania uliginosa, Acacia concinna var. fulva, Ammania dentelloides, Sonchus asper, Ipomea pilosa, Ipomea pes-tigris, Veronica anagallis, Striga densiflora, Hemigraphis hirta, Assystasia macrocarpa, Calamintha umbrosa, Amarantus polygamous Ceratophylum demersum, Aponogeton monostachyum, and A. crispum.

LIST 2

Hibiscus hirtus, Seseli indicum, Sphenoclea zeylanica, Alstonia venenatum, Assystasia gangetica, and Acanthus ilicifolius.

LIST 3

Hibiscus vitifolius, Vitis lanceolaria, Crotalaria quinquefolia, Trigonella corniculata, Lathyrus aphaca Spilanthes acmella, Nicotiana plumbaginifolia, Celsia coromandelina, Lindenbergia urticaefolia, Orobanche cernua, Barleria prionities, Blepharis molluginifolia, Girardinia zeylanica, Pilea microphylla.

LIST 4

Mollugo cerviana Ser., Malvastrum spicatum A. Gray., Crotalaria medicaginea Lamk. var neglecta, Lathyrus sphericus Retz., Tephrosia tenuis Wall., Teramnus labialis Spreng. var mollis, Fleminga lineata Roxb., Ixora parviflora Vahl. var zeylanica, Vangueria spinosa Roxb., var mollis, Heliotropium marifolium Wall., var wallichii, Evolvulus nummularius Linn., Ipomea wightii Chois., Convolvulus microphyllus Sieb. var boisseri, Alternanthera echinata Sm., Loranthus ampullaceous Roxb., Pilea peploides Hk. et Arn., Pouzolzia pentandra Benn. var ramoississima, Pouzolzia indica Gaud. var angustifolia, also var alienata, Crinum amoenum Roxb., Eulophia bicarinata Hk. f.

List 5

Buettneria jackiana Wall., Euphorbia pilosa Linn., Geranium wallichii, Sw., Atylosia barbata Baker, Deutzia stamina Br., Hyoscymus muticus Linn., Lantana crenulata Otto. & Dietr.

List 6

Delima sarmentosa Linn., Dicentra thalictrifolia Hook., Gynandropsis speciosa DC., Pittosporum eriocarpum Royle., Euphorbia hypericifolia Linn., E. prostrata Ait., Moghania macrophylla Willd., var viridis (Mukerji), Potentilla fulgens Wall., Sesuvium portulacastrum Linn., Ammania rotala F. Muell., Gynura pseudochina DC., Anotis wightiana Hk. f., Lindenbergia macrostachya Benth., Premna racemosa Wall., Strobilanthes acuminatum F. Anders., Viscum album Linn.

Science College,
Patna,
February 12, 1954.

J. G. SRIVASTAVA

59. GLEANINGS

Swan Song

The following letter appeared in the English magazine *John Bull* of 17th July, 1954 in their column 'Free Speech' (letters to the Editor):—

'A friend was crossing a bridge over the Liffey last week when he saw a fight between a swan and a cormorant. The swan was making its way upstream when the cormorant surfaced a few feet away with a large eel in its beak. The swan turned on the new comer, which dropped the eel and disappeared beneath the water. Later, the cormorant reappeared about a yard from the swan. As the swan tried to attack, the cormorant grasped its neck and held it under water. A minute or two later, a drowned swan floated away and the cormorant went on searching for food.—Alfred E. Wilson, Ballsbridge, Dublin.'

[Mr. Sálim Ali is reminded by the above of a case he witnessed in Burma many years ago of a House Crow trying to drown a rat it had in its bill, apparently disabled but still very much alive. The crow settled on a stone amid stream and deliberately dipped its booty into the water running past. After a couple of seconds it withdrew the bill in a purposeful way as if to examine the victim. Upon the squealing rat still being alive and kicking, the crow studiedly immersed it again for a few seconds more. This process would apparently have continued until the rat ceased to struggle, but after a couple more dips the bird was disturbed by passers-by. If the interpretation of the observer is correct that drowning was the object of these manoeuvres, one wonders how the birds in either case—cormorant and crow—first got the idea that their ends could be achieved thus. Surely this implies a degree of ratiocination?—EDS.]

Extracts from Other Letters to the Editor *The Field* dated March 11, 1954, page 406.

Indian Crows

'The Government here has been trying for a number of years to eliminate the Indian crow, which was introduced, it is said, by the Parsees. This bird however, is far too smart and is rapidly spreading out into the country from its stronghold in the city. Egg rewards have proved fruitless. Shortly the crows will be the only birds left on the island. Can any of your readers suggest an efficient remedy?'—O. S. Hopkin, English Club, Zanzibar.

Not the Snowman?

Sir,

During the hard frost at the beginning of February, publicity was given to reports of giant footprints, some 20 inches long, found crossing deep snow in various parts of the Isle of Wight. At the Needles they were said to lead to the edge of the 200-foot cliff with no sign of any return tracks, while at Bembridge they appeared to come from the direction of the sea and disappear inland.

Reference was also made to 'one of the world's most baffling mysteries,' recorded in February 1855, from South Devon, where similar, though much smaller, footprints, said by some to be those of Satan himself, were observed covering a large area and crossing inaccessible places like the tops of houses and narrow walls as well as in open country.

I venture to put forward an explanation of their origin. During the recent heavy snowfall, and while walking along the Yarmouth-Freshwater road where the high tide had covered the mud-flats above Yarmouth harbour, I caused numerous seagulls to take flight at my approach. As they rose from the water several of these made sudden crash-dives, repeating the performance over a considerable distance. It seemed that this was due to the frozen state of their feathers, which prevented them making any balanced or sustained flight.

Similar attempts to fly over deep snow instead of water would, I suggest, produce the effect of a series of giant footprints. A large flock of smaller birds, such as starlings may have given rise to the Devon footprints under similar conditions. These, be it noted, were described as occurring in single lines, unlike the tracks of a four-footed animal.

I should be interested to have the views of more experienced bird-watchers.

YARMOUTH, ISLE OF WIGHT. J. A. DOUGLAS

Letter to the Editor, *The Field*, dated March 4, 1954, page 356.

Cuckoos and Hawks

Attention may be drawn to Maurice Burton's note in 'The World of Science' (*Illustrated London News*, April 11, 1953) as follows:—

> 'The shadow of a hawk falling on the ground will cause a bird to utter its alarm note and seek refuge. The same thing occurs even when the hawk is a fair way off. And experiment has shown that the releaser stimulus is the short neck. When, for example, a series of cut-out silhouettes were passed over the heads of domestic turkeys, it made no difference what was the shape of the body, but a short neck was the releaser for the alarm note and a long neck called forth no response. So, a cooing dove with a short neck could send all the barnyard hens scuttling for safety, while a hawk with a long neck would raise no alarm. Indeed, we have the perfect example with sparrowhawk and the cuckoo, which in size, build and plumage are so remarkably alike: the hawk, with its short neck, releases the innate alarm behaviour; the cuckoo, with its long neck, is mobbed—even when it is stuffed.'

[In India we have several parasitic cuckoos whose close resemblance in plumage to birds of prey, and in one case to the Black Drongo, is difficult to explain. Any information regarding their habits which tends to throw light on the significance of this convergence or similarity would be interesting.—Eds.]

NOTES AND NEWS

The 9th Conference of the International Committee for Bird Preservation was held at Scanfs, Lower Engadine, Switzerland, from 23–28 May 1954, with Mons. Jean Delacour as President. Delegates from 20 countries attended, in addition to representatives of such international organisations as Conseil International de la Chasse and International Union for the Protection of Nature, and several guests and observers. The Indian delegation consisted of Mr. Sálim Ali (Chairman, Indian National Section) and Messrs. Horace Alexander and E. P. Gee (members).

The following Resolution moved by the Indian delegation was passed by the Conference unanimously, and it has been forwarded to the various national sections of the International Committee for Bird Preservation and to their Governments for appropriate action.

> ' The 9th Conference of the International Committee for Bird Preservation recommends that all Governments, especially that of the United States of America (where the greatest importation takes place), be urged to prohibit the import of feathers of the Grey Junglefowl (*G. sonnerati*) from *all* ports in the Indian subcontinent, since the habitat of this species is peninsular India *only*, and the species has suffered serious depredation in recent years.'

* * *

The XI International Ornithological Congress took place at Basel (Switzerland) from 21 May to 5 June with Sir Arthur Landsborough Thomson, C.B., F.R.S., as President. More than six hundred delegates from about 40 countries participated, including four from the U.S.S.R. The Bombay Natural History Society was represented at the Congress by Mr. Sálim Ali.

Mr. Sálim Ali was accorded the honour of being elected a member of the Permanent Executive Committee of the International Ornithological Congress (1954-1958) thereby placing India among the 8 countries represented on this Committee, and incidentally the first Asian country to be so recognised.

* * *

The Joy Gobind Law Memorial Medal of the Asiatic Society ' For Asiatic Researches in Zoology '—1953, has been awarded to Mr. Sálim Ali.

* * *

The UNESCO Budget provides funds for rendering assistance to research projects and schemes relating to arid zone development in member states. The project must relate directly to a specific arid zone problem, and should bear on some principle of general scientific interest. It must also be such as can be expected to yield results within a period of two years or one that can be continued by local support of the initial financial aid from UNESCO.

Further information may be obtained from the Ministry of Natural Resources and Scientific Research, New Delhi.

ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR ENDING 31st DECEMBER 1953

President

MR. GIRJA SHANKAR BAJPAI

Vice-President

MAJOR-GENERAL SIR SAHIB SINGH SOKHEY, I.M.S.

Executive Committee

Mr. J. I. Alfrey		*Bombay*
Mr. G. V. Bedekar, I.C.S.		
Mr. M. J. Hackney		
Mr. R. E. Hawkins		
Mr. D. N. Marshall		
Mr. D. J. Panday		
Rev. Fr. H. Santapau, S. J.		
Mr. J. A. Singh		
Mr. Humayun Abdulali	(Jt. Hon. Secretaries)	
Mr. Sálim Ali		
Mr. M. J. Dickins (Hon. Treasurer)		

Advisory Committee

Mr. H. G. Acharya	*Ahmedabad*
Sir Chintaman Deshmukh, KT., C.I.E., I.C.S.	*New Delhi*
Mr. C. H. Donald. F.Z.S,	*Scotland*
Rev. Fr. Dr. J. B. Freeman, M.A., L.T., Ph.D., D.D.	*Mysore*
Mr. E. P. Gee	*Assam*
Dr. S. L. Hora, D.SC.	*Calcutta*
Mr. C. M. Inglis, C.M.B.O.U., F.Z.S.	*Coonoor*
Col. R. C. Morris, F.R.G.S., F.Z.S.	*Attikan*
Lt.-Col. E. G. Phythian-Adams, O.B.E., F.Z.S., I.A. (Retd.)	*Nilgiris*
Dr. Baini Prasad, D.SC.	*New Delhi*

List of members of the Executive and Advisory Committees elected for the year 1954 :

Vice-Presidents

Major-General Sir Sahib Singh Sokhey, I.M.S.
Rev. Fr. H. Santapau, S.J.
Mr. Sàlim Ali

Executive Committee

Prof. S. P. Agharkar, M.A., Ph.D., F.L.S., F.N.I.	*Poona*
Mr. J. I. Alfrey	*Bombay*
Mr. G. V. Bedekar, I.C.S.	
Mr. R. E. Hawkins	
Dr. C. V. Kulkarni, M.SC., Ph.D.	
Mr. D. N. Marshall	
Mr. D. J. Panday	
Mr. D. E. Reuben, I.C.S. (Retd.)	
Mr. J. A. Singh, I.F.S.	*Poona*
Mr. Humayun Abdulali (Hon. Secretary)	*Bombay*
Mr. M. J. Dickins (Hon. Treasurer)	

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Mr. H. G. Acharya	*Ahmedabad*
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Mr. E. P. Gee	*Assam*
Dr. S. L. Hora, D.SC.	*Calcutta*
Col. R. C. Morris, F.R.G.S., F.Z.S.	*Attikan*
Lt.-Col. E. G. Phythian-Adams, O.B.E., F.Z.S., I.A. (Retd.)	*Nilgiris*
Dr. Baini Prasad, D.SC.	*New Delhi*
Major Dr. M. L. Roonwal, M.SC., Ph.D., F.N.I., F.Z.S.I.	*Dehra Dun*

HONORARY SECRETARIES' REPORT FOR THE YEAR 1953

THE SOCIETY'S JOURNAL

Parts 2, 3, and 4 of Volume 51 and the Index to Volume 50 were published during the year under report.

MAMMALS

Of the three papers published, E. P. Gee's well-illustrated account of 'The Life History of the Great Indian One-horned Rhinoceros—*Rhinoceros unicornis* Linn.' and his 'Further Observations' deserve special mention. Based on information from reliable sources and supplemented by the author's own observations, these narratives cover several little known aspects of the life of this interesting mammal, such as mating, breeding, rate of growth, life span, rhino attacking humans, noises made by the animal, etc.

As Mr. Gee emphasizes, our knowledge of the life history of the Indian Rhino is still very incomplete. He appends a questionnaire, the answers to which, if supplied by observant naturalists, would go a long way towards filling the gaps.

Desmond Vesey-FitzGerald while on desert locust control work in the Arabian peninsula in 1946, collected a few rodents on which he gives some useful field notes and ecological data in 'Notes on Some Rodents from Saudi Arabia and Kuwait'.

BIRDS

Nine papers were published in this section.

In the article entitled 'The Keoladeo Ghana of Bharatpur (Rajasthan)' Sálim Ali describes this lake as an ideal resort for wintering wildfowl. As a breeding ground for water-birds, he would rank it amongst the best in the world. Satisfaction is expressed at the Indian Bird Preservation Committee's action in recommending to the Central Government that the Keoladeo Ghana should be established as a national bird sanctuary in order that its continuance as a breeding ground of water-birds may be assured. The photographs illustrating the article, and rough estimates of the breeding population of certain species give some idea of the vast seasonal concentration of birds in this area.

'Some Breeding Birds of Singapore', in two parts, is rightly 'a pictorial record of some of the more attractive citizens of a beautiful island'. The author, Mr. W. T. Loke, whose work represents the high watermark in bird photography and has won international recognition, is well known to members of the Society through his superb photographs published every year in our nature calendars, and others in the *Journal* from time to time which are embellished by his accurate observations and facile writing.

On Bird Ecology may be mentioned the following papers:—

'Some Bird Associations of Indian Built-up Areas' by M. D. Lister and 'Ecological Notes on a Colony of Small Swallow-plovers in Mysore State' by C. Brooke Worth.

'More Notes of Birds of the Gandak-Kosi Watershed, Nepal' by Mrs. Desiree Proud is a supplement to her article dealing with the same area published in Volume 50, No. 2. It lists some additional species and gives useful notes.

Of taxonomic importance is 'Populations of Mrs. Gould's Sunbird, with comments on ranges and variation among related species of Sunbirds' by S. Dillon Ripley. Ripley recognises four subspecies of *Aethopyga gouldiae* distributed from the Himalayas through the Indo-Chinese sub-region, and shows that the subspecies *dabryii* must now be included in the avifauna of the Indian Union. Some comments on ranges and colour variations among related species are also included.

Jamal Ara's 'Count of Bird Nests in a Small Town' reports an interesting investigation in Doranda, a suburb of Ranchi, Bihar State. Out of 38 resident species only 18 were found to breed in the area. The total number of nests counted for the season was 456. A list of birds breeding outside the area is appended, and the method employed in making the counts is described.

That many birds, apart from their loud territorial song, have other songs (as distinct from the call notes) which can be regarded as secondary in nature has been recognised by many ornithologists. This, and particulars of the utterances, forms the subject-matter of 'Secondary Song of some Indian Birds' by M. D. Lister. A record, kept by the author between 1942 and 1945 of the secondary song of several species of birds in various localities, is furnished.

REPTILES AND AMPHIBIANS

The unfortunate lack of intelligent interest in these two groups of animals is reflected by the fact that nothing worthwhile was offered for publication in the *Journal* during the year.

FISH AND FISHERIES

Publication of 9 papers under this head is symptomatic of the growing importance, chiefly economic, attached to fish and fisheries.

On the natural history of fish there are four contributions of which mention may be made of E. W. Gudger's 'What Ultimately Terminates the Life Span of the Whale Shark—*Rhineodon typus*'. Included in it are the data collected during 40 years of his study of the natural history of this shark, on which the author concludes that the three factors responsible for the death of a Whale Shark are intestinal parasites, steamships and old age.

E. G. Silas while investigating the fish fauna of the Robber's Cave at Mahableshwar with the cooperation of two members of the Society's staff made a collection which included 14 common and one new species. This is described as *Puntius sahyadriensis* in his 'Notes on Fishes from Mahableshwar and Wai (Satara District, Bombay State)'.

Nemachilus evezardi the common loach—a resident of the cave did not show any adaptation to life in the perpetual darkness of the cave except for the absence of the bright colour-pattern characteristic of this species.

'The determination of Age and Growth of Fishes of Tropical and Subtropical Waters' by M. Devidas Menon is a review of the work already done, in regard to the age and growth rate of some fish in tropical and subtropical waters.

K. H. Alikunhi and Hiralal Chaudhuri published the results of their study and observations on the growth of specimens of *Labeo* (*Morulius*) *angra* (Ham.) reared in cement cisterns and nursery ponds at Cuttack, in a paper entitled 'Characteristic Colouration of Juvenile Specimens of *Labeo* (*Morulius*) *angra* with Notes on their Growth'.

C. V. Kulkarni has filled a long-felt want by publishing his 'Local and Scientific Names of Commercial Fishes of Bombay'.

On the fisheries side were published two interesting papers.

In 'Problems of Fisheries Development in Ceylon' Sundar Lal Hora and T. V. R. Pillay after a detailed study of the various factors responsible for shortage of fish on the island make some useful recommendations to remedy the situation.

'Some Interesting Methods of Fishing in the Backwaters of Travancore' by K. Gopinath, contains descriptions of four novel methods of catching fish in certain regions along the Travancore coast. These methods, the author claims, are not generally known from other parts of India but have their parallel in the commercial fishing of the Malay Archipelago and other Indonesian countries.

M. R. Ranade's 'A Checklist of Fishes Occurring in the Freshwaters of Baroda' furnishes a complete list of freshwater forms including those previously recorded. This list is particularly useful in view of the recent emphasis on the development of freshwater fisheries in that area.

That *Mugil poecilus* Day and *Mugil troscheli* Bleeker are one and the same species is the conclusion of T. V. R. Pillay after a detailed study, findings of which are published in his paper '*Mugil poecilus* Day same as *Mugil troscheli* Bleeker'.

INVERTEBRATES

Eight papers were published in this section.

'The Bionomics of Tabanid Larvae (Diptera)' by Nawab H. Khan deals with various methods of collecting and rearing tabanid larvae, the adults of which suck the blood of man and livestock, transmitting serious disease pathogens in the process. The author describes the movements of these larvae in the soil and records his observations on the effects of various ecological factors on their populations.

A. M. Patil concluded his serial 'Study of the Marine Fauna of the Karwar Coast and the Neighbouring Islands', which includes Echinoderms and other minor groups, only a passing reference being made to the vertebrate fauna of the coast, such as fish, snakes and dolphins.

G. A. Patel and H. L. Kulkarni describe a new species '*Cerciaphis emblica* sp. nov. (Fam. Aphididae)—A New Aphid Pest on *Emblica officinalis*'.

Results of detailed investigations of the life history of the common Portunid crab occurring near Mandapam are contained in 'A Contribution to the Biology of the Blue Swimming Crab, *Neptunus pelagicus* (Linnaeus) with a note on the Zoea of *Thalamita crenata* Latreille' by R. Raghu Prasad and P. R. S. Tampi.

'Host Plants, Distribution and Abundance of Thrips (*Thysanoptera*) of Bombay State' by Narayan G. Patel and G. A. Patel contains the results of the authors' survey of Bombay State for Thrips during 1950-1951. Collections from several localities in the State were estimated to include 70 species of the suborder Terebrantia and Tubulifera on different host plants. As there is very little published information on the Thysanoptera of Bombay State, this is a welcome contribution.

K. P. Ananthanarayanan and S. Venugopal reared the larvae of the Geometrid moth—*Hyposidra successaria* Wlk. on leaves of the Daincha (*Sesbania aculeata*) and published the results of their observations at every stage of growth of this pest—'Notes on the Bionomics and Morphology of *Hyposidra successaria* Wlk. A Geometrid Pest on Daincha (*Sesbania aculeata*) in Coimbatore'. The status of the pest and suggestions for its control form the concluding part of their notes.

The nature and the extent of damage to dum-nuts and its products by the Dum-nut Beetle *Coccotrypes dactyliperda* and its life-history were studied by K. R. Nagaraja Rao and I. P. Janaki who published their results in 'The Dum-nut Beetle—*Coccotrypes dactyliperda* Fabr. and its Control'. The control measures suggested should add to the usefulness of the paper.

U. S. Sharga in 'Bionomics of *Monanthia globulifera* Walk. (Hemiptera—Heteroptera: Tingidae)' furnishes illustrated descriptions of stages in the life history of this Tingid bug which caused damage to the leaves of *Osimum kilimandscharicum* grown experimentally in 1950 in Kanpur for production of camphor. This bug was previously recorded as feeding on Menthol leaves all over India.

BOTANY

Twelve papers were published in this section.

H. Santapau contributed the second part of his useful serial 'Critical Notes on the Identity and Nomenclature of Some Bombay Plants' in which the genus *Zizyphus* is dealt with. His second publication 'Notes on the Acanthaceae of Bombay' contains accounts of the genera and the species of Acanthaceae where some changes in the nomenclature and delimitation of the genus have taken place. These notes are also intended to serve as an appendix to his Monograph of this genus, published in the Botanical Memoirs of the University of Bombay No. 2.

B. Appala Naidu describes *Sesamum ekambaramii* as a new species in his 'A New Species of Sesamum'.

N. L. Bor published the first of his serial 'The Genus *Cymbopogon* Spreng. in India, Burma and Ceylon'. The author considers that a further assessment of the position of this genus of oil-yielding grasses is necessary as a large number of new species have been discovered since Dr. Stapf's first account of the genus in the Kew Bulletin for 1906. A useful key is given and the various species are described in detail together with a reference to their oil-yielding properties.

Papers on regional vegetation include three parts of M. L. Mukherji's 'Plants from East Nepal', 'Vegetation of Delhi Ridge' by Sunil Kumar Mukherjee and 'The Analytical Characters of Some of the Marshy Vegetation of Bombay and Salsette Islands' by B. S. Navalkar.

While studying the Indo-Burmese species of *Grewia* in the Calcutta and Madras Herbaria, R. Seshagiri Rao came across specimens of *Paragrewia* Gagnep. collected from Burma and Tinnevelly (South India) which he records in his 'Occurrence of *Paragrewia* Gagnep. in India and Burma'.

I. H. Burkill published the first part of his 'Chapters on the History of Botany in India: I. From beginning to the Middle of Wallich's Service' in which he records the names of all who have played an important part in the study of Indian Botany.

In the paper 'Curtis's Botanical Magazine: Its Origin, History and Mission' M. B. Raizada mentions that this magazine was founded in 1787 by William Curtis and has been in continuous publication since then. It is the oldest scientific periodical of its kind in the world, with illustrations in colour, and is unrivalled in the beauty of its production and the high standard of its contents.

A short life-sketch of William Curtis, followed by an account of the progress of the magazine from time to time, with its successive editors, is included. Raizada in conclusion appeals for support to this valuable periodical which has been of such immense use to botanists and gardeners the world over for so long.

GENERAL NATURAL HISTORY

Two interesting papers were published in this section. Part III of 'A Naturalist in the North-West Himalaya' by M. A. Wynter-Blyth is a graphic and entertaining account of a visit to Kashmir and nearby valleys. The fauna and flora met with, both during journeys and at camp sites, are recorded with useful notes concerning them. The author's quest for the 'Abominable Snowman' of the Himalayas ended in the conclusion that the foot-prints of the Himalayan Black Bear were probably mistaken by mountaineers for those of the mythical creature.

The second article, by E. P. Wiltshire, is 'Narrative of a Trek and of Natural History Observations in Kashmir in May-June 1942'. While concentrating mainly on the lepidopterous residents of Kashmir at altitudes between 5,000′ and 10,000′ in early summer, the account presents a general picture of the wild life of Kashmir as well.

WILD LIFE AND WILD LIFE RESERVES

'Wild Life Preservation in India' by Lt.-Col. R. W. Burton is the only contribution on this important topic. It was the text of the farewell address which Col. Burton delivered on April 15, 1953 at a meeting of the members of the Society in Bombay. Col. Burton reviewed the various activities, practical and legislative, of the Society and others during the past 65 years in the cause of wild life preservation in this country, culminating in the recent formation of the Indian Board for Wild Life. This is proof of the fact that the Government of India are at last fully alive to the urgent need for suitable measures to save our fast disappearing indigenous fauna before it is too late.

Topics in Col. Burton's text such as 'Some present-day Problems', 'Conservation and Control', 'Forest Staff', 'Game Fund', 'Zoological and Other Parks', 'Trade', 'Netting', 'Poaching' and 'Sportsmanship', etc., contain a wealth of information on wild life. The list of wild life literature in Appendix A, and Resolutions adopted by the Central Board for Wild Life at its first session held in Mysore from November 25th to December 1st, 1952, in Appendix B, add further to the reference value of the paper.

MISCELLANEOUS NOTES

87 notes covering almost all branches of Indian natural history of both popular and scientific interest were published.

PUBLICATIONS

The publication of the following books is in progress:—

1. The Book of Indian Butterflies by M. A. Wynter-Blyth (with the co-operation of the Government of India).
2. Some Beautiful Indian Climbers and Shrubs by N. L. Bor and M. B. Raizada.
3. Some Beautiful Indian Trees (2nd edition) by Blatter and Millard.
4. The Book of Indian Birds (5th edition) by Sálim Ali.

SCIENTIFIC EXPEDITIONS

No major expedition was undertaken during the year under review. Collecting trips to Khandala, Suriamal, Mahableshwar, Matheran, etc., in the Western Ghats were organised by the Jt. Hon. Secretary, Mr. Humayun Abdulali, occasionally accompanied by members of the staff. In the course of these a new species of hill-stream frog of the genus *Nyctibatrachus* has been discovered and it is being described in a subsequent issue of the *Journal* by Dr. J. L. Bhaduri of the Calcutta University Zoological Department.

NATURE EDUCATION

This scheme, which the Government of Bombay has been pleased to continue in recognition of its usefulness to school children, is now in its seventh year. Its normal activities, such as talks, fieldtrips, film-shows, establishing Nature Clubs in Schools, etc., have now been extended beyond city limits to Poona and Ahmedabad. In an attempt to extend the benefits of the scheme to the entire State of Bombay, the publication of an illustrated booklet on 8 common Indian birds in English, Hindi, Marathi and Gujarati has been undertaken. The booklet is priced at annas ten, but is available to school children for annas eight only. Considering that it contains 8 full-page plates in colour, it is remarkably good value, and it is hoped that proper advantage will be taken of it by schools. It is also hoped that the Bombay Government will soon decide to put the Society's Nature Study scheme on a permanent basis, so that long-term educational programmes may be planned.

REVENUE ACCOUNT

The total receipts during the year amounted to Rs. 46,317-1-8, which includes the usual grants of Rs. 8,000 and Rs. 4,000 from the Government of India and the Government of Bombay respectively, as compared with Rs. 56,900-4-10, during the previous year.

Sales of the Society's publications showed a decrease of over Rs. 2,300 as compared with the previous year. As was reported last year, this was due to the stocks of the fourth edition of the 'Book of Indian Birds' having been exhausted nearly a year ago and the fresh edition being still under print. The following is a comparative statement showing the different sources of revenue received in 1952 and 1953:—

	Revenue in 1952			Revenue in 1953			Increase in 1953			Decrease in 1953		
	Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.
Subscriptions ...	22,672	0	0	20,635	0	0	——			2,037	0	0
Entrance Fees ...	1,460	0	0	1,135	0	0	——			325	0	0
Publications :												
Books ...	6,799	0	0	4,801	0	0	——			1,998	0	0
Journals ...	3,708	0	0	3,374	0	0	——			334	0	0
Interest on Investments	3,946	0	0	3,984	0	0	38	0	0	——		
Sundries, Taxidermy, Advertisement, etc.	315	0	0	388	0	0	73	0	0	——		
Donations ...	6,000	0	0	——			——			6,000	0	0
Grants :												
Govt. of India ...	8,000	0	0	8,000	0	0	——			——		
Govt. of Bombay ...	4,000	0	0	4,000	0	0	——			——		
Total ...	56,900	0	0	46,317	0	0	111	0	0	10,694	0	0

Net decrease in revenue in 1953 compared with 1952 was Rs. 10,583.

The total number of members on our books as at 31st December 1953 was 1,091 of whom 225 were life members. Subscription for 1953 have so far been received from 676 members. During the year 54 new members joined; 3 life members and 8 ordinary members died and 35 ordinary members resigned.

STAFF

The work of the entire staff has been uniformly satisfactory during the year under report and the Committee wishes to record its appreciation of their helpful co-operation.

ACKNOWLEDGMENT

The Committee's thanks are due to Mr. P. M. D. Sanderson who continues to look after the Society's interests in the U.K.

APPENDIX TO THE HONORARY SECRETARIES' REPORT COVERING THE PERIOD JANUARY TO AUGUST 1954

A report on the Society's work during the year ended 31st December 1953 has already been handed out to you but, as a large part of 1954 has also gone by, I will refer to a few of our activities during this year.

As you are aware the Society is attempting to encourage field work among students and makes an annual grant amounting to Rs. 600 to one or more applicants interested in the pursuit of some specific piece of field work in any branch of natural history. During the current year a grant of Rs. 500 has been made to Mr. K. K. Dixit of Poona, who is studying the behaviour of Indian Honeybees with respect to colour under the guidance of Dr. Dora Ilse who has done an appreciable amount of research work in this subject.

It is hoped that these scholarships will be useful in encouraging the study of natural history in the field and that the grantees will continue their activities in subsequent years.

We have at the moment four publications in the Press: the first editions of Wynter-Blyth's 'Butterflies of the Indian Region' and Bor and Raizada's 'Some Beautiful Indian Climbers and Shrubs', the second edition of Blatter and Millard's 'Some Beautiful Indian Trees', and the fifth edition of Sálim Ali's 'The Book of Indian Birds'. Unfortunately the progress in each case is very slow, but I sincerely hope that more than one will be available by the end of this year and that its sales will help to remove the drop in receipts last year.

The Government of Bombay have not yet appointed a whole-time Wild Life Preservation Officer and Mr. J. A. Singh, who is on our Committee, is doing the best possible in addition to his work as Chief Conservator of Forests.

It is hoped, that a whole-time officer will soon be appointed and that it will be possible for him to take a more active part in the administration of the Act. Since the last report, several offences have been detected, mostly by Honorary Game Wardens, and it would be perhaps correct to say that the shooting from cars within a 100 mile radius of Bombay City has been stopped to an appreciable extent. Last year we referred to the acquittal of a person apprehended with a dead barking deer in his possession. Government appealed to the High Court and it has been ruled that the lower court was wrong in its interpretation of the law.

A lot of damage is undoubtedly still being done by cultivators holding crop protection licences. Many of them are really ignorant of the implications of the Act, and one of the first duties of the whole-time Wild Life Preservation Officer will be to explain the intentions of the Act to the 70,000 licence holders in the State and to get them to co-operate in observing the rules even without the threat of detection and arrest. Other States are also considering the adoption of legislation similar to Bombay, and in view of the continued references to these matters in the press, both local and foreign, it is hoped that the rapid depletion of wild life will be arrested and that a greater interest in wild life be aroused before it is too late. Members of this Society are of course, always expected to co-operate as much as possible in this effort.

The following 55 members have joined since the last Annual General Meeting:

From 8th August 1953 *to* 31*st December* 1953

Miss S. I. Bailey, Mangala P.O., Mysore; The Divisional Forest Officer, Panch-Mahals, Godhra; Rajkumar Prakritish Chandra Barua, Gauripur; Mr. L. D. Lovatt, Fairfield P.O., Travancore-Cochin; Dr. T. Ramachandra Rao, D.SC., Virus Research Institute, Poona; Dr. Augusto Formenti, Bombay; Mr. Ajoy Shankar Bhaduri, Sonapur Tea Estate, Assam; Mr. Mangesh Anant Malandkar, Bombay; Headmaster, Canara High School, Mangalore; Mr. Jehangir C. R. Readymoney, Bombay; Mr. R. G. Ouseley, Bombay; Wild Life Preservation Officer, Poona; Dr. R. Altevogt, Germany; Mrs. M. Choksi, Bombay; Prof. J. W. Christopher, Germany; Col. B. C. Goss, Ohio, U.S.A.

From 1*st January to* 20*th August* 1954

Miss Ruth Scott, Jiaganj, West Bengal; The Curator, Industrial Section, Indian Museum, Botanical Survey of India, Calcutta; Mr. Parikshit Majumdar, Bombay; Mr. Alan E. Leviton, Stanford University, California; Mr. M. M. Roy, Bombay; Rana Narayan Singh, Gopalpur, West Khandesh; Mr. D. S. Ellsworth, New York; Mr. K. S. Krishnamoorthy, Tirunelvelli, South India; Mrs. L, Bobb, Calcutta; Mr. Edward Malnate, Philadelphia, U.S.A; Prof. Pia Farina Liveranti, Italy; Mr. D. N. Chaudhuri, Bombay; Mr. J. W. Collins, N. Lakhimpur, Assam; The Director, Central Potato Research Institute, Patna; Dr. A. B. Misra, Hasimara Tea Estate, West Bengal; Mr. Harcharan Lal Khanna, Calcutta; Mrs. B. E. Lucas, Bombay; Mr. B. Lissanevitch, Kathmandu, Nepal; Miss I. R. Mitchell, Barrackpore, West Bengal; Mr. S. N. Agarwala, Allahabad; Mr. W. A. C. Milne, Zurrantee Tea Estate, Dooars; Mr. D. L. Amore, Bombay; Mr. R. R. Inglis-Jones, Calcutta; Mr. W. C. de Noronha, Kanpur; Mr. C. B. Ferguson, Rawalpindi; Mr. W. J. Johnstone, Digboi, Assam; Mr. S. A. Doctor, Bombay; Mr. A. Middleton, Nazira P.O.; The Secretary, Central Library, Dacca Farm, Dacca; The Chief Scientific Officer, United Planters Association of Southern India, Coonoor; Mr. A. Lindsay, Illinois, U.S.A; The Librarian, Sacred Heart College, Madurai; Dr. C. V. Kulkarni, Bombay; Dr. M. L. Roonwal, Dehra Dun; Mr. Gerald Collier. Bombay; Principal, Sree Kerala Varma College, Trichur; The Library, Infantry School, Mhow.

BOMBAY NATURAL HISTORY SOCIETY

BALANCE SHEET AS AT 31st DECEMBER, 1953

LIABILITIES	Rs A P	Rs A P
Life Membership Fees		91,293 10 8
Advance Subscriptions and Entrance Fees ...		540 0 0
Donations		2,000 0 0
Sundry Creditors:		
For Printing etc., of Journals ...	15,181 14 0	
,, 'Birds of Kutch'	26 11 0	
,, Natural History Award	100 0 0	
,, *Expenses:*		
Royalties to Authors of Books ...	225 1 0	
Expenses (Audit fee and telephone charges)	265 7 0	
	15,799 1 0	
,, Nature Education Scheme (as per statement attached)	3,565 6 0	
,, *Others:*	443 4 0	19,807 11 0
Provision for part cost of:		
1. '*Book of Indian Butterflies*' As per last Balance Sheet ...	13,000 0 0	
2. '*Some Beautiful Indian Climbers and Shrubs*' As per last Balance Sheet ...	3,000 0 0	
3. '*Book of Indian Birds*'—*V Edition* As per last Balance Sheet ...	4,000 0 0	
4. '*Some Beautiful Indian Trees*' Provision made during the year...	4,500 0 0	24,500 0 0
Surplus Account:		
Balance as per last Balance Sheet ...	51,670 7 5	
Add: Excess of Income over Expenditure ...	57 2 5	51,727 9 10
Carried forward ...		1,89,868 15 6

ASSETS		Rs A P	Rs A P
Investments: At cost			
Rs. 14,000 4% Bombay Port Trust Bonds		10,780 0 0	
,, 15,000 4% Bombay Improvement Bonds ...		11,400 0 0	
,, 36,000 3% ,, Funding Loan 1966-68 ...		35,812 10 0	
,, 25,000 3% Conversion Loan 1946 ...		25,000 0 0	
,, 2,000 3% First Development Loan 1970-75 ...		1,948 12 0	
		84,941 6 0	
(Market value on 31st Dec. 1953 was Rs. 83,684-6-0)			
£460 3% Defence Bonds		6,133 5 4	91,074 11 4
Furniture:			
As per last Balance Sheet		1,986 1 9	
Additions during the year		824 12 3	
		2,810 14 0	
Less—Depreciation...		144 3 0	2,666 11 0
Sundry Debtors			4,823 5 0
Government of India—Grants			8,000 0 0
Loans to Staff			205 0 0
Interest accrued on Fixed Deposit			143 4 0
Mammal Survey:			
Cost of skulls and skins less donations and sale proceeds—as per last Balance Sheet		3,319 2 8	
Add: Expenditure during the year ...		65 0 0	3,384 2 8
Advances for Publications:			
Some Beautiful Indian Climbers and Shrubs:			
as per last Balance Sheet	4,733 8 4		
Additions during the year	1,559 14 0	6,293 6 4	
Book of Indian Butterflies:			
As per last Balance Sheet	1,300 5 6		
Additions during the year	908 8 0	2,208 13 6	
Book of Indian Birds—V Edition		5,166 1 0	
Some Beautiful Indian Trees		10,635 1 9	24,303 6 7
Carried forward ...			1,34,600 8 7

BALANCE SHEET AS AT 31st DECEMBER, 1953—(*Continued*)

LIABILITIES	Rs a p	Rs a p	ASSETS	Rs a p	Rs a p
Brought forward ...		1,89,868 15 6	Brought forward ...		1,34,600 8 7
			Stock of Books, etc., on hand:		
			(At cost or under) as certified by the Honorary Secretary:		
			Book of Indian Birds—31 copies ...	148 8 0	
			Book of Indian Animals—871 copies ...	3,481 0 0	
			Circumventing the Mahseer and other Sporting Fish in India—437 copies ...	1,241 0 0	
			Game Birds of India, Vol. III (Bound and unbound) 399 copies	1,885 0 0	
			Indian Molluscs—849 copies	1,646 0 0	
			Birds of Travancore—17 copies... ...	323 12 0	
			Indian Hill Birds—4 copies	65 0 0	
			Flowering Trees of India (Cowen's) 1 copy	17 2 3	
			Picture Post Cards—53 Sets	37 0 0	
			Journals—14,600 Nos.	3,650 0 0	12,494 6 3
			Cash and other Balances:		
			On hand	350 0 0	
			Fixed Deposit with the National Bank of India, Ltd., Bombay	25,000 0 0	
			With the National Bank of India, Ltd., Bombay (on Current Account) ...	16,974 11 5	
			With the National Bank of India, Ltd., London, (£33-14-0)	449 5 3	42,774 0 8
Total ...		1,89,868 15 6	Total ...		1,89,868 15 6

We have prepared the above Balance Sheet from the Books of Account maintained and from the information given to us, and have verified the Investments, and Bank Balances. In our opinion such Balance Sheet represents a true and correct view of the state of the Society's affairs according to the best of our information and explanations given to us.

BOMBAY, *August 23rd, 1954.*

(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants.

BOMBAY NATURAL HISTORY SOCIETY

Dr. INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER, 1953 Cr.

EXPENDITURE	Rs A P	Rs A P	INCOME	Rs A P	Rs A P
To Salaries (including Dearness Allowance)		16,984 9 0	By Subscriptions ...		20,635 2 0
,, Contribution to Staff Provident Fund ...		965 4 0	,, Entrance Fees ...		1,135 0 0
,, Cost of Printing etc., of Journal ...		17,645 8 8	,, Journal—retail sales ...		3,373 10 0
,, Editor's Travelling Expenses ...		800 0 0	,, *Publications*:		
,, Rent ...		1,680 0 0	Profits on:		
,, General Charges ...		1,047 14 5	Book of Indian Birds ...	155 14 11	
,, Postage ...		1,030 5 5	Book of Indian Animals ...	1,543 5 7	
,, Stationery and Printing ...		451 6 6	Circumventing the Mahseer and other Sporting Fish, etc. ...	266 11 9	
,, Library (including Rs. 238-13-6, being the membership fee to the International Union for the Protection of Nature)		610 12 3	Indian Molluscs ...	222 3 0	
,, Fire Insurance ...		150 0 0	Game Birds of India—Vol. III ...	73 13 10	
,, Audit Fee ...		250 0 0	Bird Picture Post Cards ...	198 9 3	
,, Depreciation on Furniture ...		144 3 0	Society Publications (Charts) ...	42 4 9	
,, Provision for part cost of 'Some Beautiful Indian Trees' ...		4,500 0 0	Calendars ...	2,100 8 1	
,, Excess of Income over Expenditure transferred to Balance Sheet ...		57 2 5	Taxidermy etc. ...	388 0 9	
			Other Publications ...	197 6 9	5,188 14 8
			,, *Government Grants:*		
			Government of India ...	8,000 0 0	
			Government of Bombay ...	4,000 0 0	12,000 0 0
			,, Interest on Investments (Net) ...		3,984 7 0
Total ...		46,317 1 8	Total ...		46,317 1 8
Book of Indian Birds—IV Edition:					
To Stock on 1st January, 1953 ...		321 0 0	By Sales during the year ...		414 3 5
,, Royalties to Author ...		84 0 0	,, Stock on 31st December, 1953 ...		148 8 0
,, Sundry Charges—Packing, etc. ...		1 12 6			
,, Profit transferred to Income and Expenditure Account ...		155 14 11			
Total ...		562 11 5	Total ...		562 11 5
Book of Indian Animals—I Edition:					
To Stock on 1st January, 1953 ...		4,336 0 0	By Sales during the year ...		2,748 1 1
,, Royalties to Author ...		168 13 0	,, Stock on 31st December, 1953 ...		3,481 0 0
,, Sundry Charges—Packing, etc. ...		180 14 6			
,, Profit transferred to Income and Expenditure Account ...		1,543 5 7			
Total ...		6,229 1 1	Total ...		6,229 1 1

Dr. INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER, 1953—(*continued*) Cr.

EXPENDITURE	Rs A P	Rs A P	INCOME	Rs A P	Rs A P
Circumventing the Mahseer and Other Sporting Fish in India, etc.			By Sales during the year		464 10 0
To Stock on 1st January, 1953		1,351 0 0	,, Stock on 31st December, 1953		1,241 0 0
,, Royalties to Author		54 0 0			
,, Sundry Charges—Packing, etc. ...		33 14 3			
,, Profit transferred to Income and Expenditure Account		266 11 9	Total ...		1,705 10 0
Total ...		1,705 10 0			
Game Birds of India—Vol. III					
To Stock on 1st January, 1953 :			By Sales during the year		418 9 4
Bound copies	680 0 0		,, Stock on 31st December, 1953		
Unbound copies	1,350 0 0	2,030 0 0	Bound copies	535 0 0	
			Unbound copies	1,350 0 0	1,885 0 0
,, Royalties to Author		175 4 0			
,, Sundry Charges—Packing, etc.		24 7 6	Total ...		2,303 9 4
,, Profit transferred to Income and Expenditure Account		73 13 10			
Total ...		2,303 9 4			
Indian Molluscs :			By Sales during the year		392 4 0
To Stock on 1st January, 1953		1,790 0 0	,, Stock on 31st December, 1953		1,646 0 0
,, Sundry Charges—Packing etc.		26 1 0			
,, Profit transferred to Income and Expenditure Account		222 3 0	Total ...		2,038 4 0
Total ...		2,038 4 0			
Bird Picture Postcards :					
To Stock on 1st January, 1953		153 0 0	By Sales during the year		321 5 0
,, Sundry Charges—Packing etc.		6 11 9	,, Stock on 31st December, 1953		37 0 0
,, Profit transferred to Income and Expenditure Account		198 9 3	Total ...		358 5 0
Total ...		358 5 0			
Nature Calendar 1954 :			By Sales during the year		6,404 6 10
To Cost of Printing, etc.		3,762 4 0			
,, Sundry Charges—Packing, etc.		541 10 9			
,, Profit transferred to Income and Expenditure Account		2,100 8 1			
Total ...		6,404 6 10	Total ...		6,404 6 10

BOMBAY, *August 23rd, 1954.*

(Sd.) A. F. FERGUSON & Co.,
Chartered Accountants.

BOMBAY NATURAL HISTORY SOCIETY

NATURE EDUCATION SCHEME

Receipts and Payments Account for the Year ended 31st December, 1953

RECEIPTS	Rs	A	P	PAYMENTS	Rs	A	P
To Balance with the Society on 1st January, 1953	2,974	9	6	By Cost of Plant Study Sheets	221	0	0
,, *Grant from Government of Bombay :* 1953/54	5,740	0	0	,, Salary of Nature Education Organiser (1-1-53 to 31-12-53) ...	4,695	0	0
,, *Plant Study Sheets*—Sales	151	14	6	,, Postage	128	11	0
				,, General Expenses (Stationery, Conveyance, etc.) ...	256	7	0
				,, Balance with the Society	3,565	6	0
Total ...	8,866	8	0	Total ...	8,866	8	0

BOMBAY, *August 23rd, 1954.*

(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants.

MINUTES OF THE ANNUAL GENERAL MEETING OF THE BOMBAY NATURAL HISTORY SOCIETY HELD IN THE CONFERENCE HALL OF THE B.E.S. & T. UNDERTAKING, ELECTRIC HOUSE, ORMISTON ROAD, BOMBAY, ON MONDAY THE 23rd AUGUST 1954, AT 6 p.m. WITH REV. FR. H. SANTAPAU, S.J., IN THE CHAIR.

1. The Honorary Secretaries' Report for the year ended 31st December 1953 having been circulated was taken as read. The Jt. Honorary Secretary then enumerated the activities of the Society during the period January to August 1954.

2. The balance sheet and statement of accounts presented by the Honorary Treasurer were approved and adopted.

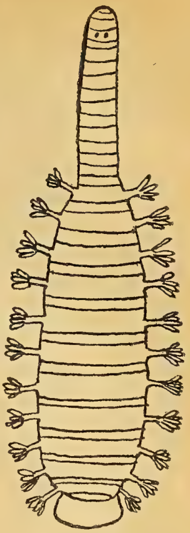
3. The Committee's nominations to the Executive and Advisory Committees, as previously circulated to members, were accepted.

After the normal business of the meeting concluded, Mr. Sálim Ali gave a talk on his recent visits to some bird haunts in the U.S.A. and Europe and showed a colour film which was greatly appreciated by all present.

Dr. Willard Hartman of the Peabody Museum, Yale University, New Haven, U.S.A., would be glad to receive for study purposes specimens of land leeches—*Haemadipsas* spp., large freshwater leeches of any genus, and *Ozobranchus shipleyi* Harding, a gill-bearing aquatic leech living on freshwater turtles of the genus *Kachuga* (see sketch).

Method of preservation: Allow leeches to expand in container of fresh water. Add 70% alcohol dropwise at intervals over a period of half an hour until a concentration of 35-40% is reached. When animals are relaxed and unresponsive to touch, put them in 10% formalin.

If specimens are sent to the Society preserved as above, they will be forwarded to Dr. Hartman.



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Vol. 52, No. 4

Editors
SÁLIM ALI & H. SANTAPAU, S.J.

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Habits and Habitat of Some Common Spiders Found in Western India. By T. V. Subrahmaniam. (*With* 16 *text figures*) ... 874

Some Birds Collected in Langtang Khola, Rasua Garhi District, Central Nepal. By O. Polunin 886

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PAGE

5. Bird Life. By Niko Tinbergen. (S.A.) 905
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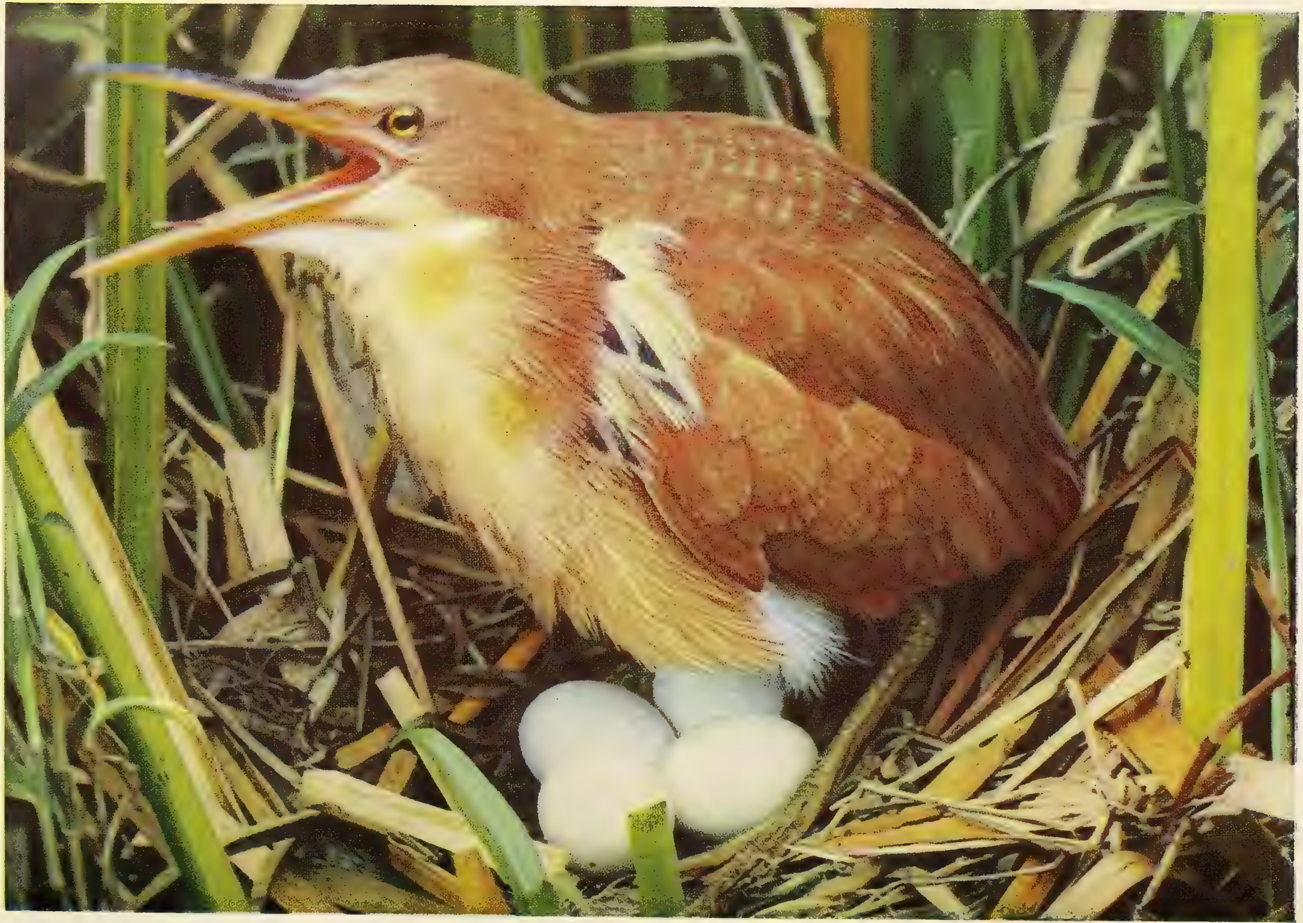
1. Strange behaviour of Monkeys in the presence of a Panther. By Sirdar Bhupendra Kumar (p. 913). 2. Unrecorded sounds made by the Tiger. By Lt.-Col. R. W Burton (p. 915). 3. Cat and Mongoose. By T. Gay (p. 916). 4. Extraordinary behaviour of a solitary Bull Bison (Gaur). By R. C. Morris (p. 916). 5. The Brow-antlered Deer (*Cervus eldi* MacClelland) (*With a plate*). By E. P. Gee (p. 917). 6. Thamin or Brow-antlered Deer in the Zoological Gardens, Rangoon (*With a plate*). By Tun Yin (p. 919). 7. Abnormal Horns of a Blackbuck (*Antilope cervicapra*) (*With a photo*). By C. H. Biddulph (p. 920). 8. Notes on the Desert Hedgehog (*Hemiechinus auritus collaris* Gray). By Ishwar Prakash (p. 921). 9. Cannibalism in Hedgehogs. By Ishwar Prakash (p. 922). 10. Wild Life Preservation in India—The area of the former Gilgit Agency. By Lt.-Col. R. W. Burton (p. 923). 11. New Light upon the Natural History of Malabar. By C. H. Biddulph (p. 924). 12. A bird answering its own echo. By T. Gay (p. 925). 13. Another Bird-watching pilgrimage to SW Tibet (*With a map*). By K. S. Lavkumar (p. 925). 14. Has the Cuckoo a protrusible ovipositor? By Charles McCann (p. 931). 15. Mating of Partridges. By Editors (p. 932). 16. The Bone-dropping habit of the Lämmergeier. By Robert L. Fleming (p. 933). 17. Heron-keeping on the Indus River (*With a photo*). By P. I. R. Maclaren (p. 935). 18. Trapping birds for ringing (*With a photo*). By Zafar Futehally (p. 936). 19. The record Indian Crocodile. By Lt.-Col. R. W. Burton (p. 937). 20. Some notes on *Rana beddomii* Günther with an extension of its range. By Humayun Abdulali and J. C. Daniel (p. 938). 21. Presumptive eating of a Krait by Scorpions. By Ishwar Prakash and K. C. Dave (p. 939). 22. A grateful skink. By T. Gay (p. 940). 23. Hunting the Land Crab (*Paratelphusa guerini* (M.-Edw) (*With 1 text figure*). By Jabir A. Ali (p. 941). 24. Apus (Crustacea: Phyllopoda), a new host for parasitic nematodes. By K. K. Tiwari (p. 945). 25. An Unusual Crab fishery in the sea off Ennur, near Madras (*With 1 text figure*). By P. I. Chacko and E. Palani (p. 946)). 26. A new species of *Antrocephalus* Kirby (*With 1 text figure*). By B. R. Subba Rao (p. 948). 27. Some Insects attracted to light—II. By S. Usman (p. 950). 28. Notes on *Thrips palmi* Karny attacking *Sesamum indicum* (*With 1 plate and 1 text figure*). By T. Ananthakrishnan (p. 951). 29. Aposematic insects and their food plants. By D. G. Sevastopulo (p. 953). 30. A Four-leaved Oleander. By G. W. Deodhar (p. 954). 31. On the Occurrence of *Marsilea aegyptiaca* Willd in Jodhpur, Rajasthan (India) (*With 1 plate*). By K. M. Gupta (p. 954). 32. *Alternanthera polygonoides* R. Br. var *erecta* Mart—A new record for Bombay State (*With a plate*). By G. P. Shrivastava and H. Santapau (p. 957). 33. Abnormalities in the 'Ear' of *Zea mays* L. (*With 1 plate*). By S. L. Tandon (p. 958). 34. The introduction of *Tilapia mossambica* into India—A correction. By Editors (p. 959). 35. Gleanings (p. 959).

NOTES AND NEWS 961
ERRATA 962
AN APPEAL 962



Kodachrome *Loke Wan Tho*

The Yellow Bittern

Female

JOURNAL

OF THE

BOMBAY NATURAL HISTORY SOCIETY

1955 VOL. 52 NO. 4

TWO BITTERNS IN A PENANG MARSH

BY

LOKE WAN THO

PART I

(*With* 1 *coloured and* 3 *black & white plates*)

Behind the village of Ginting, on Penang Island, there is a great area of low-lying but fertile land where rice is grown. In the months which follow the harvest, these ricefields, or 'bindang', left untended by man, become a vast sea of reeds which only the wind touches with its invisible hands. Here, where nature has re-entered into possession, her tenant creatures of the wild move in after her.

The Rails make their home in this intricacy of reeds, in the midst of which they chase about and squabble noisily. The Bitterns too live here, but in silence, making their furtive way along well-trodden lanes, so that even when the grass around is cut, force-of-habit makes them follow a path to the nest which no longer conceals them. Two different species of Bitterns live in good neighbourly relations, and often their nests are placed so close together that they might almost be called colonial nesters: one species is the Yellow Bittern (*Ixobrychus sinensis*), and the other the Chestnut Bittern (*Ixobrychus cinnamomeus*).

THE YELLOW BITTERN (*Ixobrychus sinensis*)

The Checklist of the Birds of Malaya describes the Yellow Bittern as a 'passage migrant and winter visitor', and for a long time it was believed by the best authorities that the bird did not nest in Malaya. However, Mr. James Cairns, a resident of Penang, after prolonged and careful observation, established the fact that the Yellow Bittern was a fellow-resident, both of the island and the mainland in Province Wellesley. Mr. Cairns's findings were set out in a paper, entitled 'The Yellow Bittern', which he wrote for the *Malayan Nature Society Journal*, (Vol. IX, No. 1, June 1954, page 11),

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and, in the same issue, he also contributed a further note entitled, 'Notes on Two Families of Yellow Bittern' (page 28), which was illustrated by a photograph of the nest taken by F. G. H. Allen.

Mr. Cairns had, already in 1953, invited me to visit Penang to try and obtain photographs of the bird, but despite good intentions which went so far as to send up my hide in advance, business problems kept me inactive in ornithology throughout the whole of the year.

In 1954, soon after my return from a round-the-world trip, I again received a message to say that a nest had been found, and once more inviting me to go up to photograph the bird. An opportunity once lost, seldom recurs, but now the fates had given me another chance and so, despite the fact that my mouse-like nibblings had as yet failed to make any impression on the mountain of work on my office table, I took the first aeroplane to Penang, arriving there on Sunday morning, August 22nd, 1954, at just after 11 o'clock.

Cairns, and my brother Loke Wan-yat, were waiting for me; the former was dressed for a day in the marshes, and we must have made a strangely contrasted pair, the one with his jungle clothes and boots, and the other, straight from the big city of Singapore, still too natty to look a naturalist. I soon changed my clothes in the car, and once arrived in the ricefield area of Ginting Village, we lost no time but plunged into the marshes. I was dressed in my field grey shirt and khaki trousers, and carried over my shoulder a black tripod which bore a strong resemblance to a Bren-gun stand: the thought crossed my mind that I must have looked suspiciously like a bandit, and I wondered whether a member of the security force, if he saw me, would challenge first before he fired, or would shoot first and ask questions afterwards. The question was perhaps only academic, even though terrorists had but recently been discovered in the hills behind Ginting Pass. I have, fortunately, not had the experience of a good friend of mine who, on one occasion, found it necessary to have his revolver lying beside him as he sat in his hide, and I hope I never shall; but it shows that bird photography in Malaya sometimes has a pioneering quality about it.

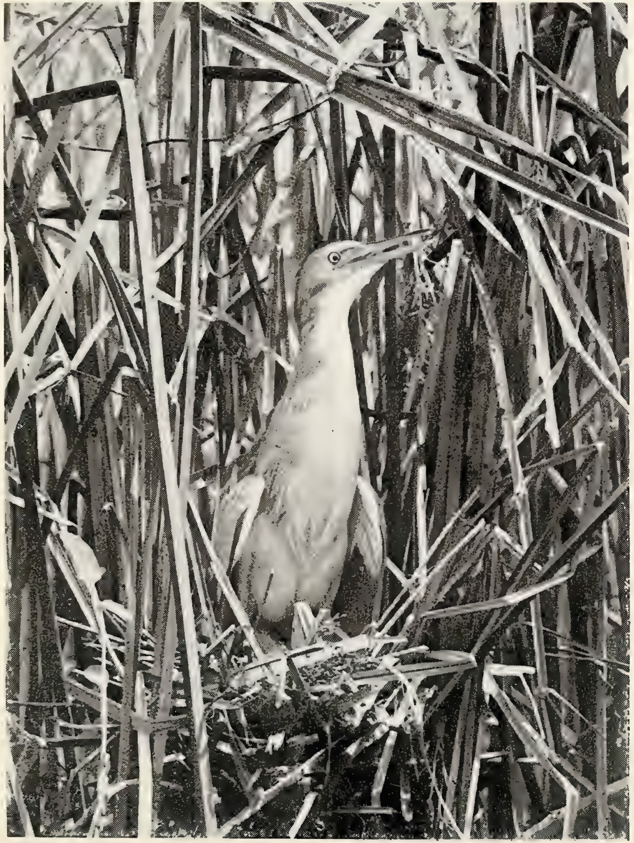
The object of our attention was a nest containing four young, the biggest of which was about 14 days old. Inside the hide, it was like a furnace, and there were times when I felt quite faint: I had had no food since 6 a.m., and it was not until nearly 6 p.m., before I again had something to eat. A wait of four hours was merely time wasted; the adult birds never returned. Two of the young were big enough to clamber out of the nest and they quickly proceeded to do so, and no doubt their parents were in the vicinity to entice them. In the end, I had to admit defeat.

Meanwhile Cairns, and his assistant Ralli, had scoured the marsh and discovered three other nests of the Yellow Bittern, and one of the Chestnut Bittern. We went over to look at them, and as we did so flushed a pair of the Yellow adults. They gave an impression of contrasting colours of pale fawn and black, the male bird being lighter in shade. After flying a short distance, they dropped into the reeds.

The swamp area of Ginting, Penang.

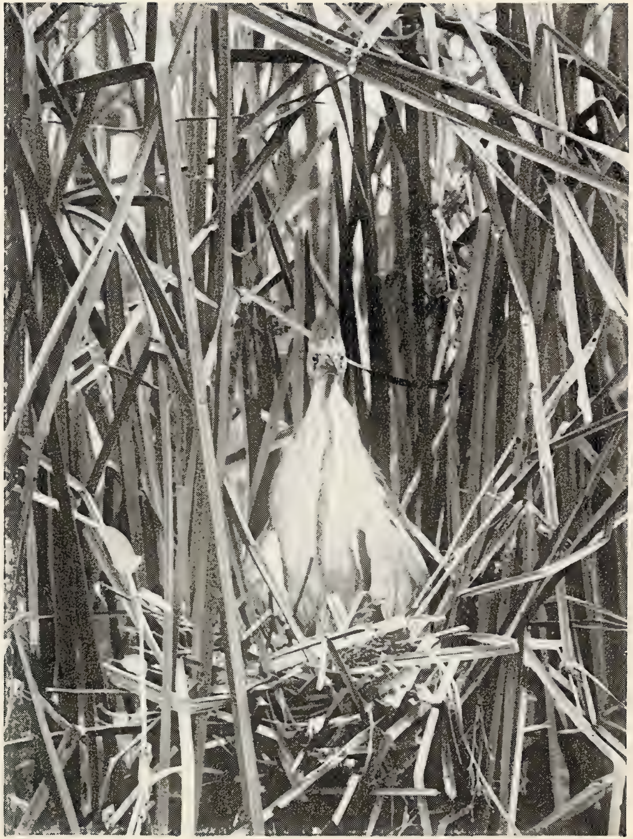
"Looking like a bandit with a Bren-gun stand."
(*Photos: Author*)

THE YELLOW BITTERN



Photos

Male



Author

Female

“ . . . raised her crest in threat.”

The first of these new nests of the Yellow Bittern contained two young birds and one egg (one juvenile had only recently emerged from the egg, and its downy feathers were still damp, while the egg showed signs of chipping); the other two nests each contained three eggs, of a pale greenish blue colour. The first nest was clearly the most suitable for photography, so we erected the hide and left it in place overnight.

All the nests were built some three feet off the ground, and were astonishingly small for so large a bird, measuring roughly 4 inches by 4 inches. Constructed of reeds and slender twigs which formed a slightly hollow pad, they were placed on an interlacing of reed-stems. Above the nests, a few of the growing stems had been pulled together to form a rough canopy.

Elsewhere than in Malaya, nest-sites of a different kind have been found. Stuart Baker, for instance, quotes Oates as saying that in Pegu,

> 'common as this bird is, its nest is one of the most difficult to find and, when found, to secure. It selects the matted leaves of immense reeds, and places its nest on the summit where wind and rain have entangled the leaves and worked them into a platform. The nest itself is a mere pad of dry grass and leaves.'

Or, Valentine Irwin, who noted in Comillah how, inside a clump of rushes,

> 'doubled into the smallest imaginable space, was a Yellow Bittern, on a little rush-and-reed nest built on the top of a small mud pillar, which projected about 6 inches above the water-level . . . .'

Stuart Baker himself writes that in Assam, where the Yellow Bittern is extremely common in suitable areas, the bird,

> 'builds its nest most often in reeds, rushes or Elephant-grass round the edges of the swamps and lakes, but seems to place them indifferently at all heights above the water from an inch or two to three feet or more, though I have never seen the nests on the summits of the reeds as recorded by Oates. I think most often the nest is quite low down, as low in fact as the tangled mass of broken debris will allow it to be placed, which may be a couple of inches above the water, or it may be so matted as to fill all the interspaces between the reed-stems to a considerable height.'

La Touche writing of the bird in China says that,

> 'It nests abundantly in the swamps on the Yangtse and in the marshes of North China, building its nest on the reeds. In the South it builds as well on bamboos and on trees, the banyans on Shameen (Canton) being specially mentioned by Vaughan and Jones as selected by the birds . . . . The nest in the reed-beds of the Yangtse is composed of flags or reed-leaves; where built on bamboos, twigs, straw and bamboo-leaves in quantity are used, and the nests on Shameen are said to resemble those of *I. cinnamomeus*'.

The comparison with the nest of the Chestnut Bittern is particularly interesting because, in Penang, the two cannot be confused. The nest of *I. cinnamomeus*, in the reed-beds of Ginting, is larger and flatter than that of *I. sinensis*, and is placed lower down, being but a few inches above the level of the water; in the words of Cairns, they look like 'a diminutive Harrier's nest'.

Early on the Monday morning I set out once more to try conclusions with the Bitterns: it was a Monday black with storm clouds, and as we neared Ginting Pass the rain, which earlier had begun to fall, became heavier and heavier as we proceeded until I felt that it would be useless to carry on. I therefore asked the driver to turn the car round and go back, but no sooner done than my conscience began to nag at me, and would give me no rest until I had made up my mind not to give up till I had at least got as far as the nest-site. So we turned round again, and drove into heavier and yet heavier rain until it seemed as if it would be sheer stupidity to persevere. And yet, as we reached the top of Ginting Pass and began to descend on the other side, the rain miraculously ceased, and the sun peered out of heavy clouds.

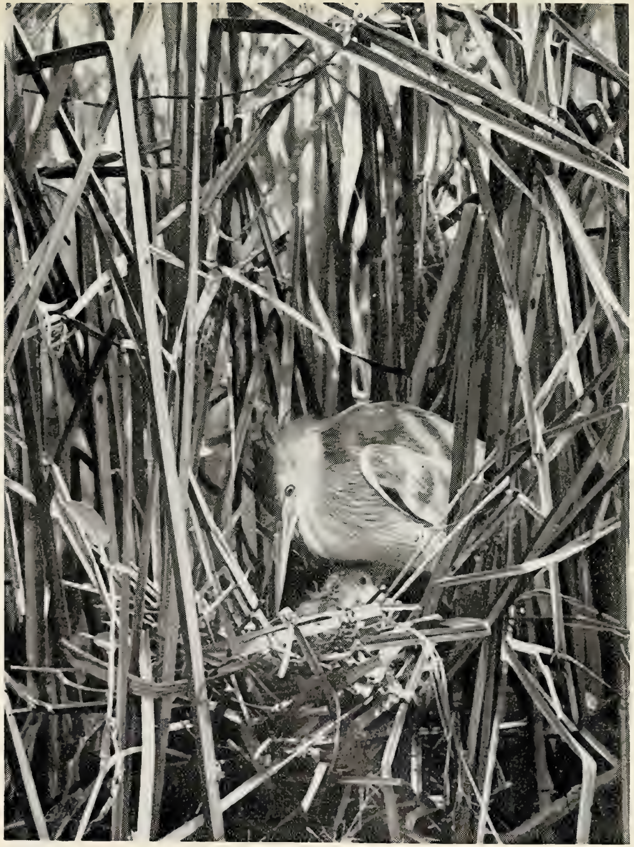
Arrived at the scene of the nest, the tripod and camera were quickly set up inside the hide, and my helpers left me to my vigil. The female Bittern quickly returned, showing no fear of the strange contraption of painted cloth a mere 6 ft. away, and at once began to brood the young and to incubate the single egg. During a space of some 40 minutes, nothing much happened, and I had a good opportunity to study my beautiful sitter.

Her general coloration in flight is a light-brown or buff, with contrasting buff-and-white wings, but at close quarters the beautiful details of her plumage could be admired at leisure. Her back was a rich brown, and the upperparts heavily streaked; the underparts were a pale straw or sand, and a heavy, dark brown streak ran down the chin, throat and breast, with lighter streaks on either side. The crest was dark slate; the eyes, yellow, with a tiny red spot below each one; the tail black and the legs yellow. There was a quaint patch of blackish feathers, with buff edgings, on either side of the base of the neck, and similar patches were later noted also in the Chestnut Bittern.

At 10.00 a.m. the male returned. There was no room on the tiny nest for both adults at the same time, and as the male moved in, the female moved out. They raised their crests at each other in salute.

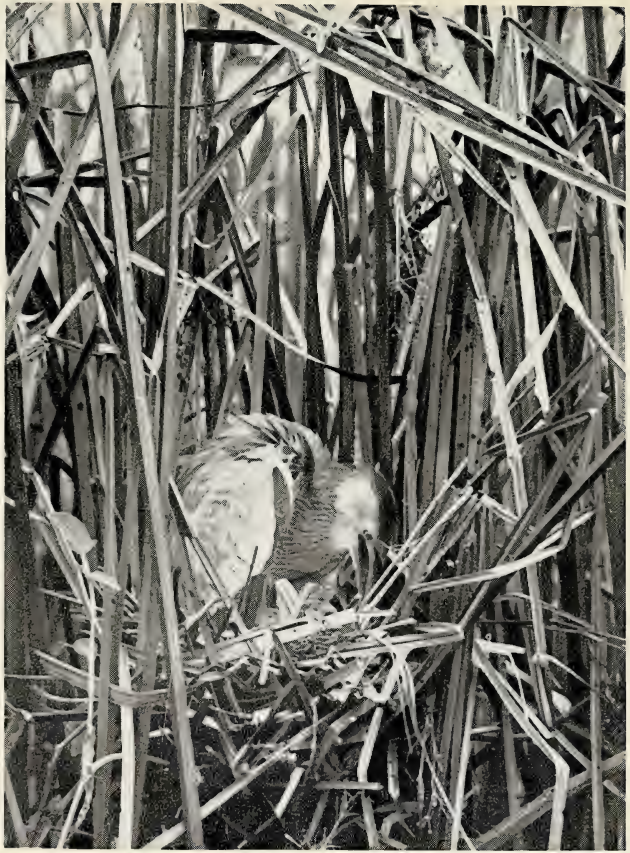
The cock bird was handsomer than his mate. His general coloration, seen in flight and in the field, is somewhat paler brown than the female. Here, at close range, I was able to observe a beautiful maroon back, only a faint brown streak down the centre of the breast, and a number of brown-and-white, hairlike feathers on each side of the base of the neck. The curious patch of dark feathers with light edgings was also to be seen, but only when the bird hunched his shoulders. The base of his bill was yellow, and the culmen dark horn with a reddish line below it.

Not long after the return of the male, the third egg hatched. Unfortunately, I was not able to witness this exciting spectacle which I have seen only once in my life; my eye was just on a level with the rim of the nest, and this prevented me from being able to peer



Photos

" . . . kept butting father in his belly . . . "



Author

Emptying the Larder.

(Note oily feathers, and patch of dark feathers at base of neck.)

into the bottom of the shallow nest-depression. I realised what had happened only when the adult picked up half the eggshell and took it away for disposal, the remainder of the broken pieces were later eaten.[1]

At 10.30 a.m. the chicks were fed by regurgitation. Plate IV shows the adult in the act of food-production. A shiny black worm or caterpillar, about 1½ inches long, was manipulated up the oesophagus and was quickly pounced on by the hungry youngsters. One chick, after the manner of his heron kind, seized the adult's bill and wrestled with it, but because of his tender years he was unable to treat father with that rough disrespect which he would undoubtedly show later on. A total of some 4 or 5 shiny black worms was produced.

After this festive interlude, the male settled down to incubating his brood, stretching out his wings to protect them from the increasing heat of the sun. One obstreperous youngster, more precocious than his brethren, kept on butting father in his belly so that he had to shift his position several times.

At 11.00 a.m. the female returned, and as cock and hen passed each other, they again politely raised their crests. The female did not feed the young, but was merely content to act as an umbrella, shading her young from the sun. Her throat vibrated in the heat, and she never took her eyes off the hide. Any noise from within made her stare hard, and sometimes she raised her crest in threat. The minutes passed quickly as I took a series of pictures, both in black-and-white and colour.

A short time before noon, the rumble of thunder could be heard from the hills, and the rain quickly followed. We had just time to dismantle equipment and hide and make a run for it, reaching the car just as the rain fell. And so the day ended, as it had begun, with a downpour, but fortune had already smiled on me, and like the poet, I breathed a prayer of gratitude:

> 'Ah, but those tears are pearl which thy love sheds,
> And they are rich and ransom all ill deeds'.

(*To be continued*)

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[1] As the second egg hatched on Sunday (22-8-1954), and this third one hatched on Monday (23-8-1954), it is clear that the eggs of the Yellow Bittern are laid on consecutive days, but incubation begins as soon as the first egg is laid.

TECTONIC HISTORY OF INDIA AND ITS BEARING ON FISH GEOGRAPHY

BY

S. L. HORA, D.SC., F.N.I.

Director, Zoological Survey of India, Calcutta

(*With 7 text figures*)

INTRODUCTION

As is well known, Geography is a synthetic science, largely dependent for its data on the results of specialized sciences such as geology, oceanography, meteorology, biology, etc. 'The characteristic task of geography is to investigate the control exercised by the forms and vertical relief of the surface of the lithosphere directly or indirectly on the various mobile distributions.'[1]

The distribution of freshwater fishes has been greatly neglected in the past for it does not fall easily into the zoogeographical regions established for mammals or birds. The mode of dispersal of fishes, in spite of suitable ecological niches in their neighbourhood, is dependent on drainage patterns, river captures, flood plains and other phenomena which may help in the commingling of waters of different drainage systems. Further, fishes of various ecological associations can only spread if suitable environmental conditions become available in the intervening areas. For instance, torrential fishes cannot spread over marshy areas though the overflooded waters of a torrent may spread over marshy grounds. Of all the factors responsible for the spread of fishes, the tectonic history of a country can be most fruitful in the study of their distribution. The Indian fish-geographers are, therefore, fortunate in the publication of a recent *Memoir* of the Geological Survey of India by its Director, Dr. M. S. Krishnan, on 'The Structural and Tectonic History of India'.[2] It contains a wealth of material, which was otherwise inaccessible to biogeographers. The language, though unavoidably technical, is quite understandable by a lay reader, especially because the text is illustrated with a number of diagrams and maps. For more serious students of the subject, the author has given a list of references covering 8 pages and an index covering another 8 pages.

STRUCTURE OF INDIA

Structurally, India has been divided into two units, the Peninsula and the extra-Peninsular area. As the stratigraphic and tectonic histories of the two regions are different, Dr. Krishnan has treated them separately up till the Tertiary, when they encroached on and influenced each other.

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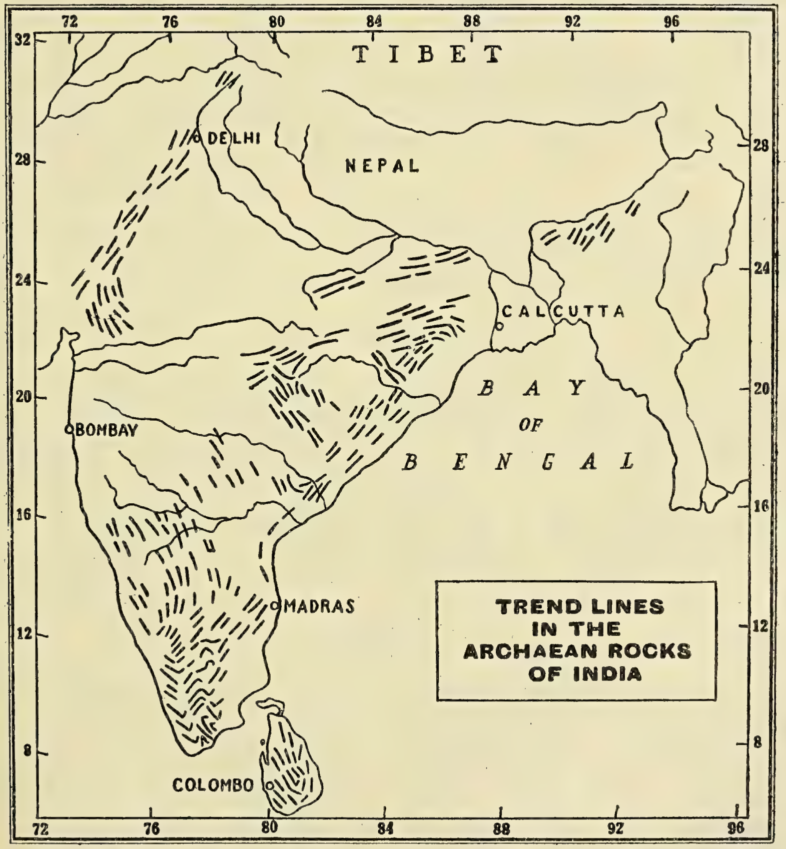
[1] *Encyclopaedia Britannica*, 14th ed., **10** : 139 (1929).

[2] Published in 1953 as *Memoirs* Vol. 81, and obtainable from the Geological Survey of India, 27, Chowringhee, Calcutta 13, for Rs. 2-8.

The present writer has the intention to deal with only such facts recorded in this *Memoir* as have bearing on the Fish Geography of India.

TREND LINES IN THE ARCHAEANS

The trend lines in the Archaeans have influenced the later geological phenomena to a marked extent, though they are much older than the organisms which occupied the country from time to time. The earliest known freshwater fishes of India are now entombed in the Maleri (Triassic) and Kota (Jurassic) beds of the Godavari Valley.[1] The trend lines noticeable in the Archaean rocks of the different parts of India represented by Dr. Krishnan in fig. 1 indicate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DELHI
NEPAL
CALCUTTA
BAY OF BENGAL
BOMBAY
MADRAS
COLOMBO
TREND LINES IN THE ARCHAEAN ROCKS OF INDIA

TEXT-FIG. 1.—Trend lines in the Archaean rocks of India. After Dr. M. S. Krishnan (*Mem. Geol. Survey of India*, **81**: 4, 1953).

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[1] Hora, S. L. & Menon, A. G. K. (1952): Distribution of Indian Fishes of the past and their bearing on the Geography of India. 2. The extinct freshwater Dipnoan and Ganoid fishes of India. *Everyday Science*, **1**: 26-37.

the route of migration of fishes from north-east to south-west. All the freshwater fish fossil beds (besides Maleri and Kota beds referred to above, we have Dongargaon, Deothan and Kheri beds of the Cretaceous-Eocene periods[1] in Madhya Pradesh) are situated along these trend lines. It is thus reasonable to infer that these trend lines though indicating the mountain chains and axes of rock-folding in the Archaean era have persisted and, have greatly influenced the drainage patterns of the Triassic, Jurassic, Cretaceous and early Eocene periods.

Though Dipnoan, Ganoid and Osteoglossid fishes died out in India, they are still living in some other parts of the world. The causes of their extinction are violent changes in their ecological conditions and the outpouring of lava over a greater part of the country. With regard to the former, one reads that 'The humid conditions which permitted the growth of luxuriant vegetation in the Permian gave place to dry continental conditions in the Triassic. The sediments of this period are red sandstone and sandy clays (Panchet and Mahadeva Series) probably laid down in lakes' (pp. 21-22). After desiccation during the Triassic period, moist conditions returned again when another invasion of freshwater fishes took place. During the Middle and Upper Jurassic, dry conditions returned again and the fish fauna of the Kota period died out in India. From the Upper Cretaceous to Lower Eocene there were several outbursts of lava flows and the fossils from the infra- and inter-trappean beds tell the tale of the circumstances under which the fauna was entirely wiped out from the areas covered by the trap formations.

Garo-Rajmahal Gap

In zoogeographical studies, the gap between the Garo and the Rajmahal hills has received considerable attention in recent years. Regarding the Assam Plateau, Dr. Krishnan points out that 'though now separated from the main peninsula area by a broad strip of the Ganges-Brahmaputra alluvium, there is no doubt that the Assam plateau is part of the peninsular shield. It appears to have been covered by the sea from the Jurassic or Cretaceous onwards and to have experienced the effect of the Tertiary movements of the Himalayan and Burmese area in that it was uplifted in the Miocene' (pp. 12, 13). The distribution of the Dipnoan, Ganoid and some of the earliest Teleostean fishes from the mainland of Asia to India from the Triassic to the early Eocene periods shows that the peninsula was continued north-eastwards to China. Dr. M. S. Krishnan tells me that during the Triassic and a part of the Cretaceous periods there were dry continental conditions in south-west China and Yunnan. During those periods north-eastern India might well have been connected by land with China through the Sadiya region.

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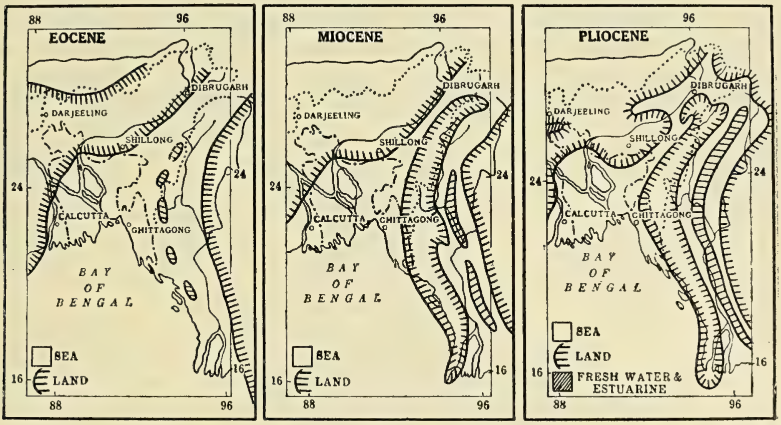
[1] Hora, S. L. & Menon, A. G. K. (1953): Distribution of the Indian fishes of the past and their bearing on the Geography of India. 2. The Extinct Freshwater Teleostean fishes of India. *Everyday Science*, **2**: 105-113.

The western side of the Assam plateau is marked by fracturing which may be connected with the formation of the Garo-Rajmahal Gap. Minor oscillations have occurred even in the Pliocene and Pleistocene times, and these movements may have accentuated the original faults and made the Gap more pronounced while it was still covered by the sea. It would appear that structurally the Gap is a very old feature of the topography of India,[1] though ecologically it became suitable for the migration of freshwater fishes during the glacial epochs of the Pleistocene.[2] Its present-day physical features seem to have been attained after dismemberment of the Indo-Brahm River when the Ganga and the Brahmaputra began to flow through it to the Bay of Bengal. The fault became filled up through the sediments brought down by these rivers and now the alluvium lies several hundred feet thick at Rajmahal.



TEXT-FIG. 2.—The Garo-Rajmahal Gap area under the sea during the Eocene, Miocene and Pliocene periods. After M. S. Krishnan (*Bull. Nat. Inst. Sci., India*, **1**: 26-28, 1952).

Another point which seems clear now is that though the Assam Plateau was uplifted in the Miocene, the area of the Garo-Rajmahal Gap continued to be under the sea during the Pliocene and a greater part of the Pleistocene.

THE DECCAN TRAPS

According to Dr. Krishnan (p. 52), 'The Deccan Traps now occupy some 2,00,000 sq. miles and must have formerly covered a more extensive tract, probably twice the present area. They are regarded as having been erupted from numerous fissures in the crust during a period of tension. They are estimated to have a thickness of over 6,000 ft. near the Western Ghats, but much less in other areas. They must originally have extended also for an unknown distance to the west of India but that part was faulted down in or about the Miocene'.

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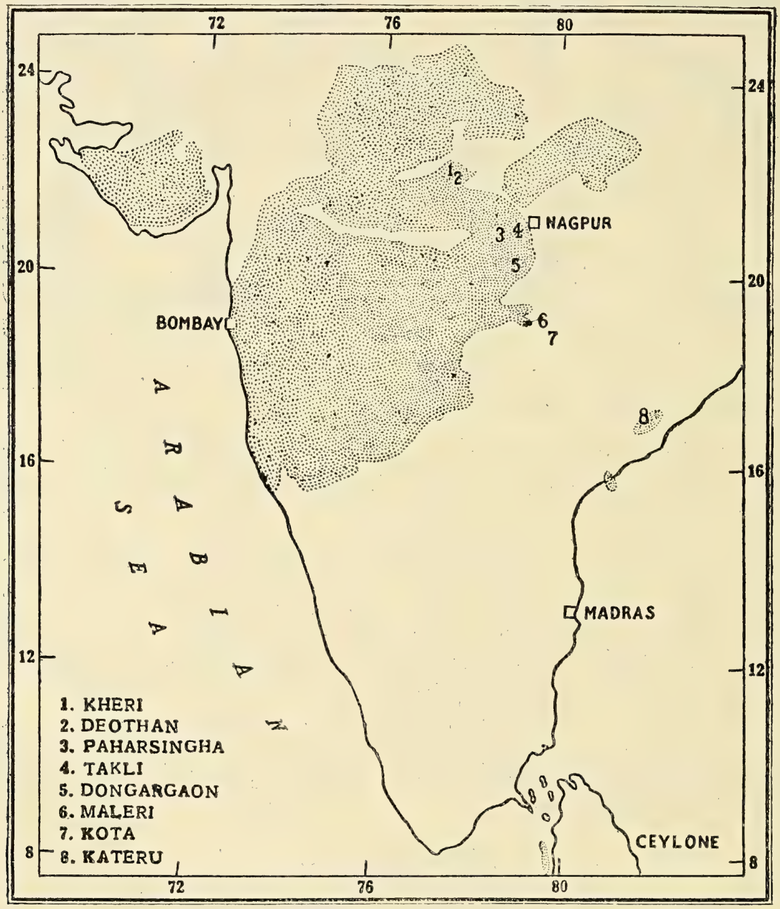
[1] The presence of Lower Gondwana rocks along the western edge of Garo Hills may indicate the possibility of the structural weakness having arisen here in L. Gondwana times, according to Dr. M. S. Krishnan.

[2] Hora, S. L. (1951): Some observations on the palaeogeography of the Garo-Rajmahal gap as evidenced by the distribution of the Malaya fauna and flora to Peninsular India. *Proc. Nat. Inst. Sci., India*, **17** (6): 437-444.

Trap formation seems to have played a great part in Indian zoogeography for the fauna that reached the Peninsula upto the early Eocene period was totally destroyed in the area of the traps which was then perhaps twice its present extent. Some of the early Eocene fishes have, however, persisted in the extreme south of the Peninsula and Ceylon[1] because the Traps did not extend beyond 15°N.



TEXT-FIG. 3.—The present-day extent (shaded portions) of the Deccan Traps with the positions of infra- and inter-trappean fossil beds marked in it. After S. L. Hora (*Proc. Nat. Inst. Sci., India*, **4** (4): 398, 1938).

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[1] Silas, E. G. (1954): Speciation among the freshwater fishes of Ceylon. *Bull. Nat. Inst. Sci., India*, No. 5 (in press).

latitude in the south. The age of the Deccan Traps is now admitted to be uppermost Cretaceous extending well into the early Eocene period. It was at the close of the Trap formation that transgression of the Bay of Bengal took place and probably severed India's land connection with the mainland of Asia in the Chinese region.[1] Thus there was no new freshwater fish migration to the Peninsula from the north-east till the conditions became favourable again, firstly by the regression of the Bay of Bengal during the Pliocene and secondly by the Garo-Rajmahal Gap becoming dry land during the glacial periods when the sea level fell by 100-200 meters. Later the Gap became filled up by the sediments carried down by the Ganga and the Brahmaputra Rivers. These assumptions are supported by the fact that there are no post-Trappean freshwater fish fossils known from the Peninsula.

BAY OF BENGAL

In order to explain the so-called Malayan affinities of the freshwater fish fauna, the earlier zoogeographers conceived of a land connection between the Peninsula and the Malayan subregion across the Bay of Bengal. Dr. Krishnan (p. 60) adduces stratigraphical evidence to show that the eastern coast of India took shape during the Jurassic. It is therefore reasonable to believe that an incipient Bay of Bengal had already made its appearance in the Jurassic.

INDIA-AFRICA LAND CONNECTIONS

There is considerable evidence that during the Pliocene and early Pleistocene the freshwater fish fauna of India migrated to Africa along a northern route,[2] for the main connection over the Peninsula seems to have been cut off when the land beyond the western coast was faulted in the Lower Miocene or earlier. 'Since Middle Miocene rocks have been involved in the downfaulting of the Mekran Sea, the date of faulting may be late Miocene or Pliocene. It may be that the western coast of India was faulted down in Lower Miocene and the faulting extended into the Mekran region somewhat later. Further extension of this faulting into the Persian Gulf and the Euphrates Valley apparently occurred in the Pleistocene' (p. 64). Though the Triassic, Jurassic, Cretaceous and early Eocene waves of migration of freshwater fishes passed over the Peninsula to Africa, only the northern route was available when the freshwater fishes appeared again in the Pliocene.

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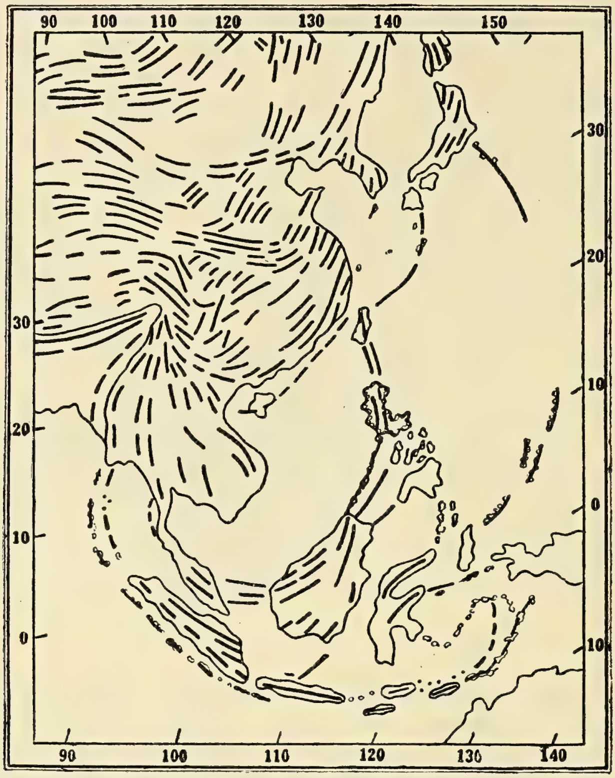
[1] With regard to the migration of the Malayan fauna, Dr. M. S. Krishnan states 'that a ridge was formed (which is now the Arakan ranges and their continuation) during early Eocene, and it was apparently uplifted further during the successive pulses of the Alpine Himalayan movements. This separated Assam from Western Burma in both of which marine conditions continued till much later in the Tertiary period. This parting ridge, or rather its base, will have provided the land connection necessary for migration of freshwater and torrent loving fishes'.

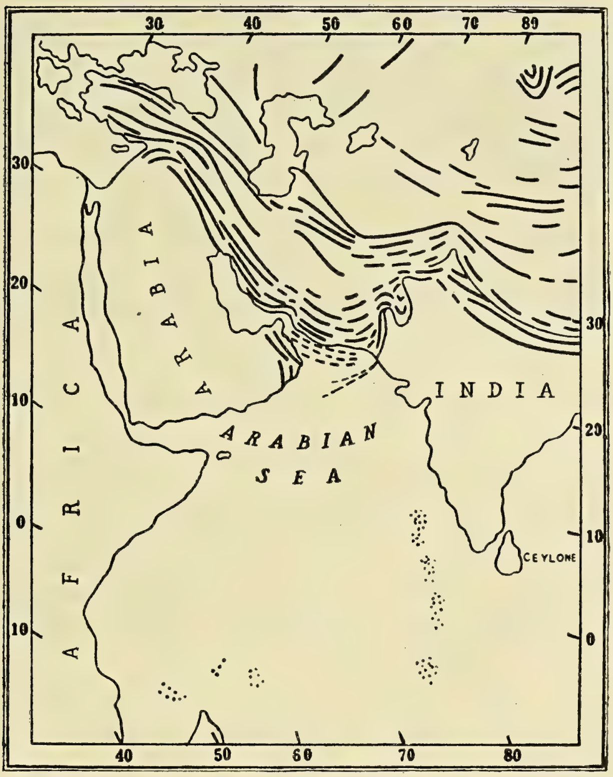
[2] Wiseman, J. D. H. & Sewell, R. B. S. (1937): The Floor of the Arabian Sea. *Geo. Mag.*, 74: 219-230.



TEXT-FIG. 4.—Radial distribution of mountain arcs of south-east Asia, the pivotal point being the Assam syntaxis of the Himalayas. Modified after M. S. Krishnan (*Mem. Geol. Surv., India*, **81**: 25, 1953).

RADIAL DISTRIBUTION OF SOUTH-EAST ASIATIC FRESHWATER FISH FAUNA

Fish geographical studies carried out in the Zoological Survey of India since 1937 have shown that the freshwater fish fauna of south-east Asia is radially distributed from the south-west Chinese or Yunnan region. This is due to the pattern of distribution of the mountain arcs of southern Asia. Dr. Krishnan's map on p. 25 (Text-figs. 4 and 5) brings out this radial distribution in a remarkable way and beautifully explains the dispersal of the torrential fishes of this part of the world. When a mountain arc is uplifted a foredeep is usually formed at its base which would account for the radial distribution of the sluggish water fishes also. For instance, the alluvium-filled trough through which the Ganges flows in the North Indian plains is of the nature of a foredeep, a slight buckling down of the upper crust in front of the convex mountain arc. The


30
40
50
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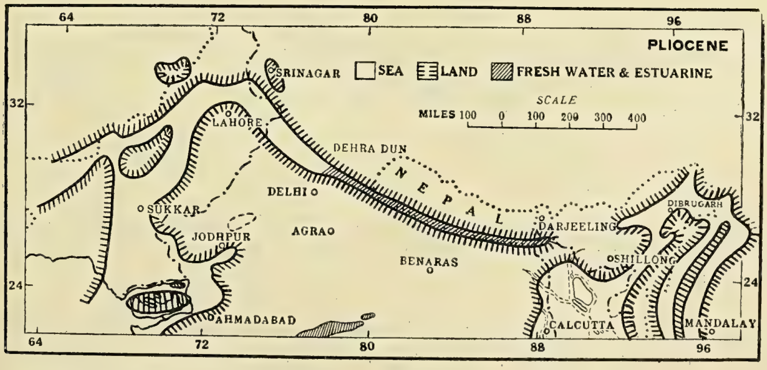
0
10
AFRICA
ARABIA
ARABIAN SEA
INDIA
CEYLONE
30
20
10
0
40
50
60
70
80

Text-fig. 5.—Continuation of the Himalayan arc westwards into the Alpine system. Modified after M. S. Krishnan (ibid, **81** : 25).

Brahmaputra Valley in Assam is a continuation of the same feature. The thickness of the alluvium is variously estimated to be between 6,000 to 10,000 ft.


64
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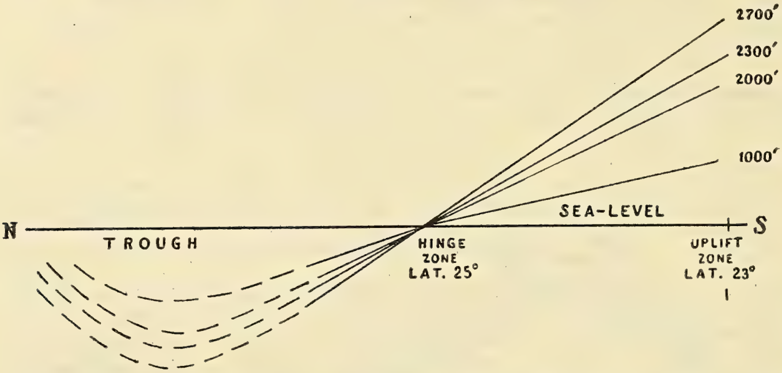
PLIOCENE
SRINAGAR
SEA
LAND
FRESH WATER & ESTUARINE
SCALE
MILES 100 0 100 200 300 400
32
32
LAHORE
DEHRA DUN
NEPAL
DELHI
SUKKAR
JODHPUR
AGRA
BENARAS
DARJEELING
DIBRUGARH
SHILLONG
24
24
AHMADABAD
CALCUTTA
MANDALAY
64
72
80
88
96

Text-fig. 6.—Pliocene foredeep of Himalayas which later gave rise to the Siwalik Hills and during Pliocene helped in the distribution of freshwater fishes from east to west. After M. S. Krishnan (*Bull. Nat. Inst. Sci., India,* **1** : 28, 1952).

In the early Pleistocene, this foredeep ran as the Indo-Brahm River at the base of the Himalayas, following its curve, from Assam to the Arabian Sea. The Miocene-Pliocene foredeep is now raised up as the Siwalik hills forming the outer Himalayas (Text-fig. 6). The Siwaliks extend from China, through India along the Alpine-Himalayan chain of mountains. The distribution of freshwater fishes fully supports such a palaeographic feature of these regions.

OTHER POINTS OF BIOGEOGRAPHICAL INTEREST

In the above few paragraphs, I have tried to show how helpful can be Dr. M. S. Krishnan's *Memoir* in the study of biogeographical problems. It is needless to say that there are many other points in it to which attention could be directed. For instance, (i) a marine transgression of Middle Miocene separated Ceylon from the mainland by a very shallow sea (p. 89); (ii) to the north of the Himalayan region is a belt of negative anomalies passing through the Pamirs and Ferghana Valley where the free-air anomalies are said to attain magnitudes of about minus 150 milligals. Mushketov has suggested that this region is one of recent uplift in addition to having been affected by the Himalayan orogeny (p. 82); (iii) the Himalayan orogeny affected the southern flank of the 'fore deep' at each stage thereby it suffered elevation. In Chota Nagpur, Bihar, four regional uplifts have been noted—1. Lower Tertiary uplift of 1,000 ft.; 2. Middle Tertiary (Mid-Miocene?) uplift of 1,000 ft.; 3. A further uplift of 300 ft.; and 4. A still further later uplift of 400 ft. Dr. Krishnan notes that along latitude 25°N. there was practically no movement, this being of the nature of a hinge zone located somewhere of the southern limb of the trough (pp. 58, 59) and (iv) there are evidences of the recent uplift movements of the Himalayas. For instance, the Siwalik Zone bordering on the Gangetic plains is thrust over by the Miocene rocks in the Kalka region below Simla. The Karewa



TEXT-FIG. 7.—The epeirogenic uplift of Chota Nagpur Plateau in four stages. Copied from Dr. M. S. Krishnan, after J. A. Dunn (*Mem. Geol. Surv., India*, **73**: 141, 1939).

formations in Kashmir, of Middle Pleistocene age, are known to have been uplifted a few thousand feet on the flanks of the Pir Panjal range. The Second Interglacial deposits, which contain the remains of early tool-making man, have suffered uplift in the North-western Himalayas. In parts of the Eastern Himalayas, especially in the Darjeeling and Bhutan regions, the thrust masses have advanced on the plains, the age of the thrust being later than the Upper Siwalik Conglomerate (i.e. Pleistocene).

A student of Indian biogeography will find answers to many of his riddles in Dr. M. S. Krishnan's *Memoir* on 'The Structural and Tectonic History of India' and it will be equally useful for the zoogeographical studies of the Oriental Region as a whole.

SOME STUDIES ON TWO SPECIES OF INDIAN FIDDLER CRABS, *UCA MARIONIS NITIDUS* (DANA) AND *U. ANNULIPES* (LATR.)

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(*With* 13 *figures and* 1 *table*)

CONTENTS

PAGE

A. INTRODUCTION AND PRESENT KNOWLEDGE 702

B. MATERIAL AND METHODS 703

C. 1. THE FIDDLER CRABS OF BANDRA, BOMBAY, AND THEIR BIOTOPE ... 705
(*a*) Temperatures at various spots of the Habitat 706
(*b*) Behaviour towards Enemies 707
2. Feeding 707
3. Waving, Fighting, 'Territory' and Copulation 709
4. Burrow digging 714

D. SUMMARY 715

E. LITERATURE 716

A. INTRODUCTION AND PRESENT KNOWLEDGE

The sexual dimorphism in fiddler crabs of the genus *Uca* has aroused the interest of a number of workers since the first half of the last century. Its bearing on problems of anatomy, physiology, behaviour and evolution has been studied in various places and led to quite different, and sometimes contradictory, opinions as to the meaning and function of waving. Thus F. Müller (1869), C. Darwin (1871) and A. Alcock (1902) thought that waving is a means of recognition among the sexes, and that by waving the males attract the females. Other authors like A. S. Pearse (1912-1914) and J. Verwey (1930) favoured the opinion that by waving the males only demarcate their dwelling and feeding territory, and that it has nothing whatever to do with courtship and sexual behaviour. The same view is emphasized by H. Hediger (1930 *a*, *b*) who studied *Uca tangeri* Eydoux, the fiddler crabs on the estuary of the Regreg River in French Morocco. Extensive studies on *Uca*-species of the American coasts by J. Crane (1941-1943) showed that 'waving definitely plays a large part in courtship' (1941, p. 152) and 'that each species proved to have a definite, individual display, differing . . . markedly from every other species observed' (ibid.).

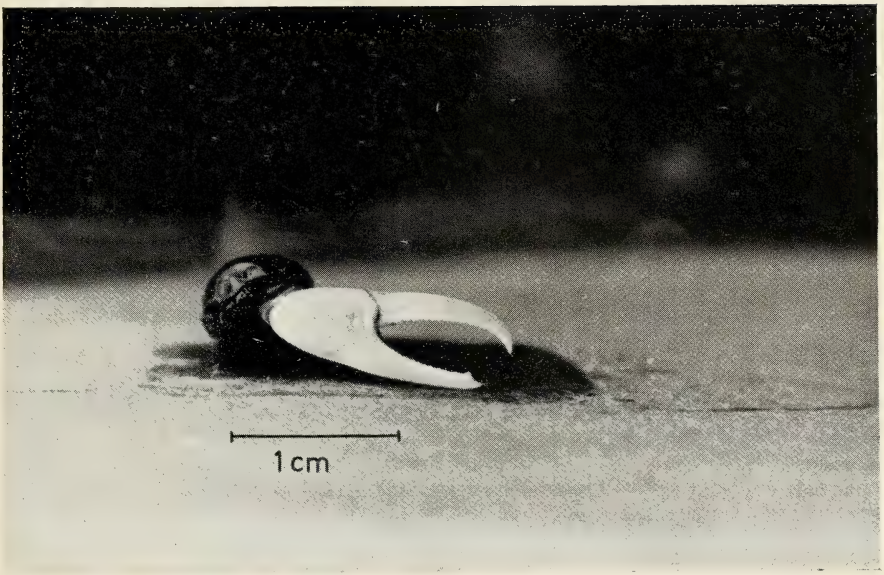


Fig. 2

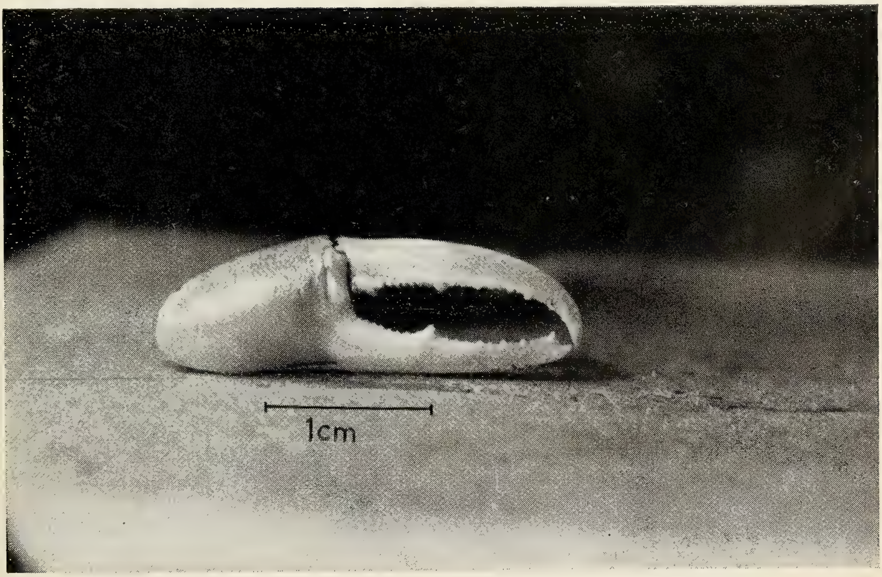
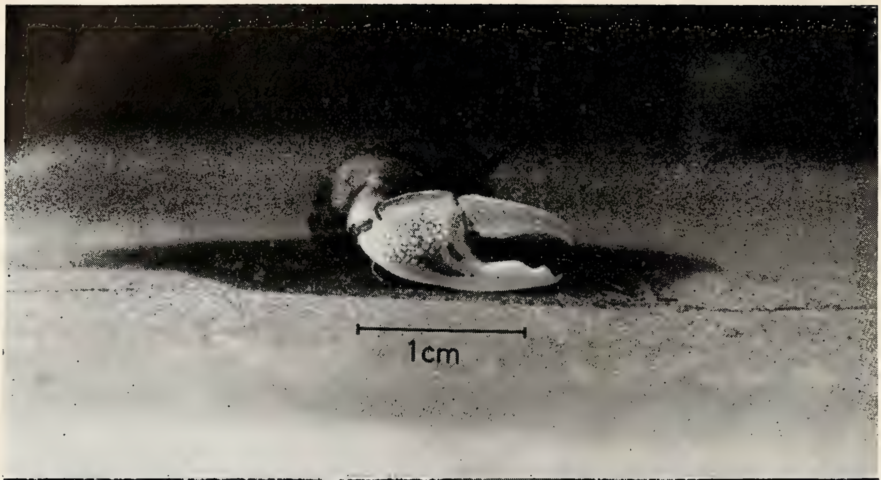


Fig. 3.
Major cheliped of a small (upper) and large (lower) specimen of *Uca annulipes*.



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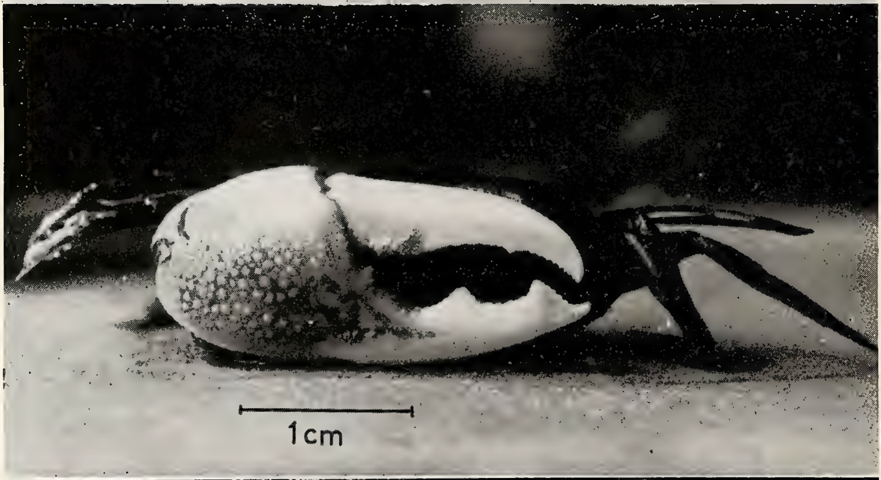

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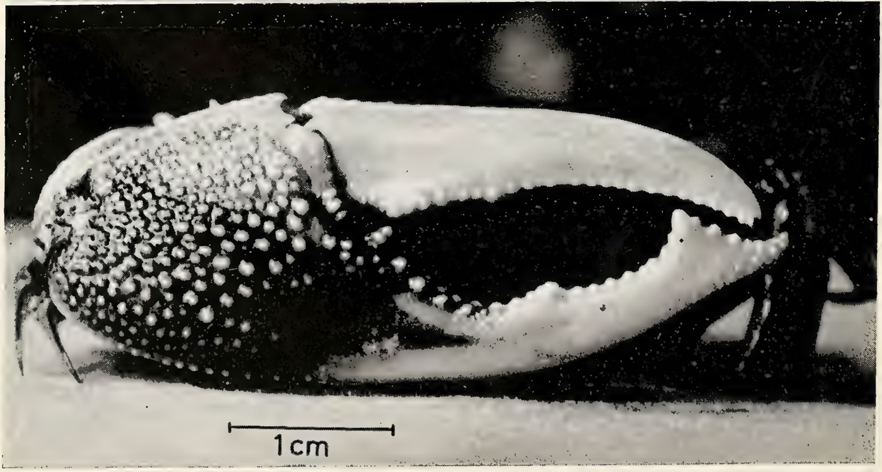

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Figs. 4-6. Major cheliped of a small, medium and large specimen of *Uca marionis nitidus*.

Since J. Crane's work no studies seem to have been done on *Uca*[1]. Regarding the Indian species of this highly interesting group of Crustacea there are no reports available except those by A. Alcock (1902) who observed *Gelasimus annulipes* (= *Uca a.*) on the mud flats of the Godavari and Kistna banks and—though not directly relevant—by J. Verwey who studied *Uca signatus* Hess and a few other species near Batavia. As sufficient knowledge about *Uca* in general and the Indian species in particular is lacking, each further study on them is to be appreciated. And it is for this reason that the following notes—incomplete as they are—are given, which, moreover, are hoped to encourage some competent Indian readers to further observations and investigations on the subject.

B. Material and Methods

After a zoological excursion to India in 1953, which was headed by Professor Dr. B. Rensch and aided by grants from the 'Deutsche Forschungsgemeinschaft' and the Ministry of Culture of Nordrhein-Westfalen, I could stay for two weeks near an *Uca*-bank on the beach in Bandra (Bombay). This was mainly made possible by the generosity of our Indian friends Sálim Ali and Humayun Abdulali in whose house I lived quite close to the beach and could work nearly all day except, of course, during high tides. In determining the crabs observed and collected I was greatly aided by Dr. R. Bott (Senckenberg-Museum, Frankfurt Main), who also compiled the list of synonyms cited below. That I could personally compare the *Uca*-material of the Bayrische Staatssammlungen is due to the friendly help of Dr. W. Engelhardt, Munich. My warmest thanks are due to all the persons and institutions mentioned.

The period of observation lasted from 24-5-1953 to 7-6-1953. Sitting on a stone I could easily keep a close watch on the inhabitants of an area chosen at will and measuring about 11 sq. yds. A 6 × 30 binoculars proved useful and even necessary for detailed observation of certain movements of the animals. Since so little is known about the type of waving, which apparently varies from species to species, and about the peculiar technique of feeding, which still remains a sort of mystery to zoologists, even the slightest details are worthy of record. Luckily enough I could take some motion pictures covering the feeding, waving, and burrow digging of the crabs with a 16 mm. Bolex cine camera. Back home these pictures proved very useful in determining the frequency of feeding and waving movements, the method of digging and transporting the mud-pellets, and so on. Individual crabs were marked by fixing labels of yellow cloth on their backs with waterproof glue. Thus I could 'shadow' and re-recognize them quite easily after the tides. In watching *Ucas* it is absolutely necessary to keep as quiet as possible, because even the slightest movement on the part of the observer sends the crabs scuttling down into their holes. A person at rest, however, does not seem to disturb them at all, even at fairly close quarters.

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[1] Recently, H. M. Peters has visited some *Uca* places of El Salvador; his observations are about to be published, while the taxonomic results of his visit have just appeared in R. Bott: 'Dekapoden aus El Salvador. 1. Winkerkrabben (*Uca*)'. *Senckenbergiana Biologica*, **35**: 155-180, 1954.

At the end of the watching period a number of *Ucas* was preserved in 10% formaldehyde for determining the species and for studies on the spoontipped hairs (J. Crane 1941). These minute but important structures are to be found on the inner edge and wall of the merus of the second maxilliped. For anatomical details, position and terminology of the mouth-parts concerned see fig. 1. Measuring the width and length of these spoontipped hairs was done from photographs taken with the Leitz microphotography-set and a Leitz-microscope.

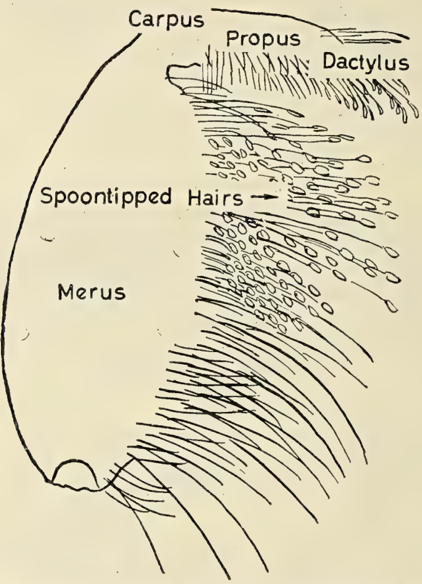

FIG. 1 The anatomy of the second maxilliped in *Uca*.

The temperatures in various spots of the biotope were measured thermo-electrically with an instrument by Dr. Goedecke and Kleemann ('Gekatest') the error of which is ± 1/10°C. in the range from 21°C. to 41°C.

There were two species of fiddler-crabs living side by side in the biotope, which can be easily told from each other once the main features of differences in shape, size and colour have been mastered. The smaller species (carapace sizes of observed and collected individuals measured up to 15 × 11 mm.) is *U. annulipes* Latreille (figs. 2 and 3). The large cheliped of the males shows a fairly smooth external surface of manus, dactyl and pollex, and there are no noticeable tubercles except on the base of the lower margin of the manus where a ridge of small tubercles can be felt. The gape between pollex and dactyl is made up by straight to smoothly curved lines of small serrations which are interrupted only by 2 to 4 more prominent teeth on the inner edge of dactyl and pollex (see fig. 2). Waving males of this species

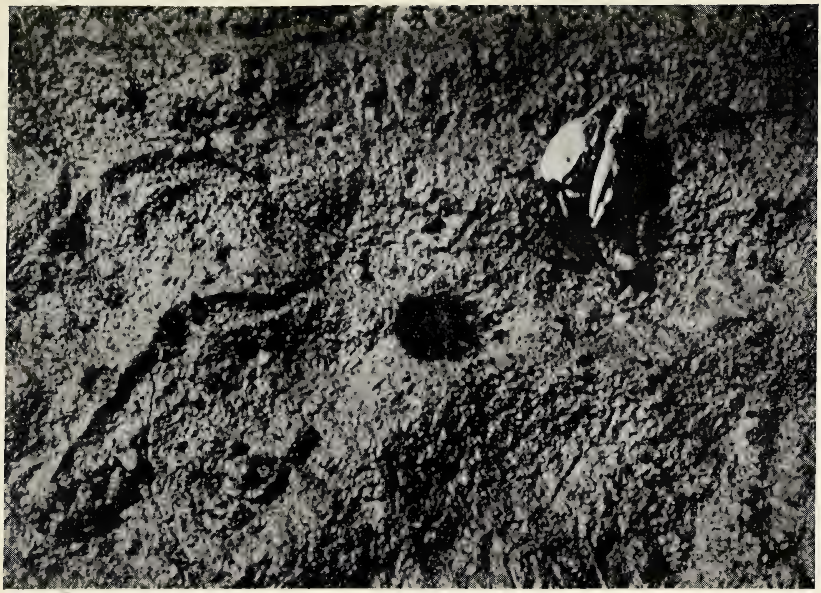

Fig. 7. *Uca marionis nitidus*, habitat and hole.

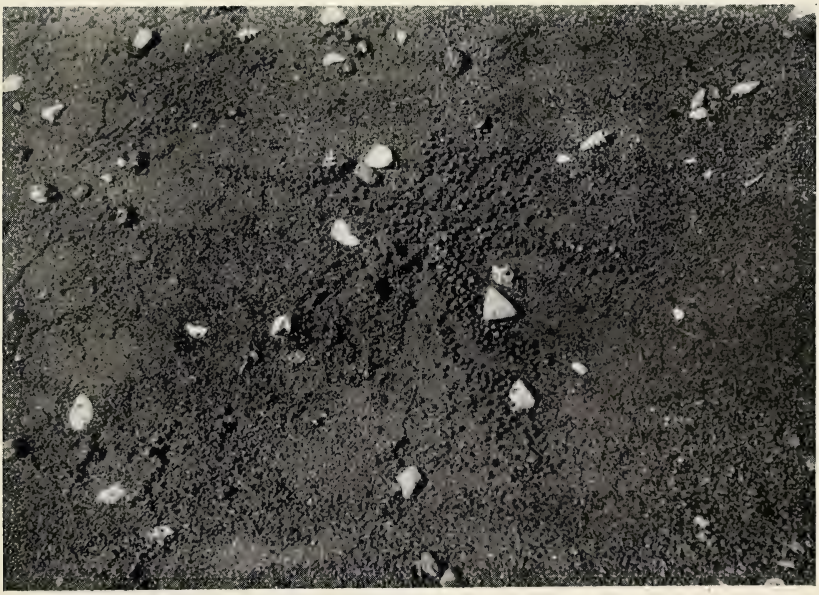

Fig. 8. Refused mud-pellets of *Uca* in linear arrangement radiating from entrance of crab's hole.

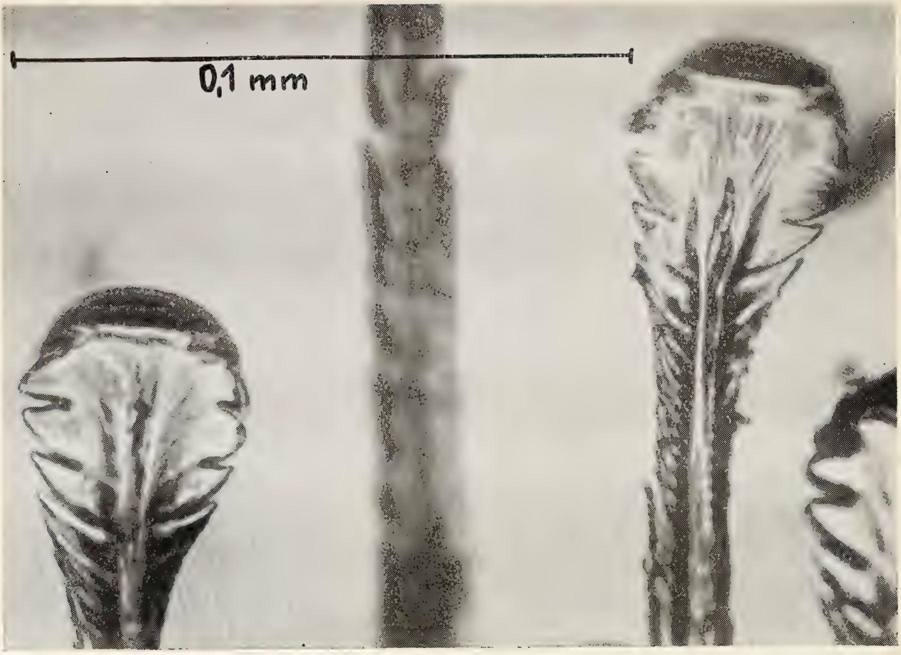

Fig. 9

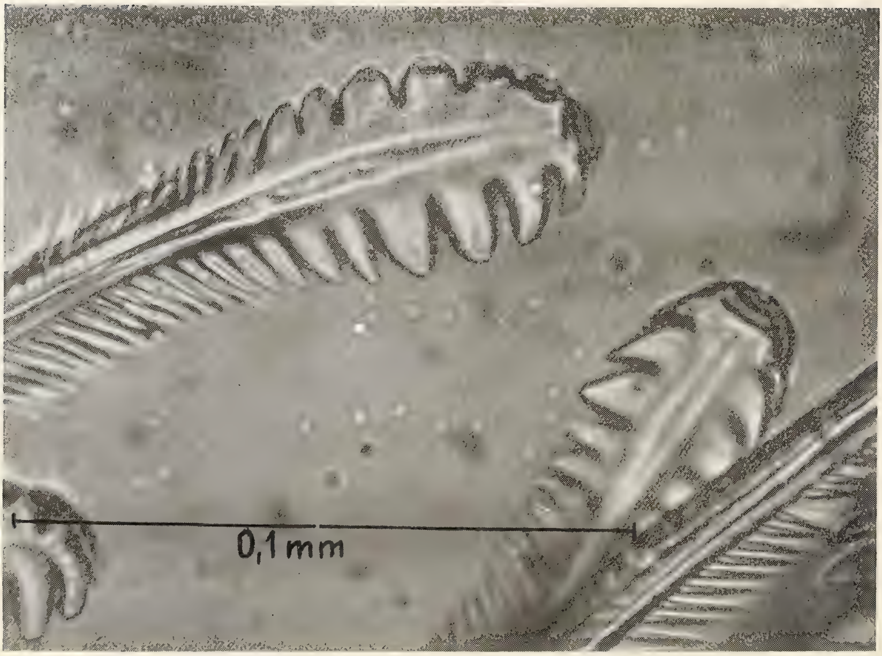

Fig. 10

Spoontipped hairs of merus of second maxilliped in *Uca marionis nitidus* (Fig. 9) and *U. annulipes* (Fig. 10) display a bright cherry-red colour of the manus in the large cheliped which can change into whitish.

In the second *Uca*-species concerned, the colour of the large cheliped is between yellow-orange and red, but never as bright. This second species is *U. marionis* (Desmarest) f. *nitidus* (Dana) (figs. 4-6), which, on the average, is definitely larger than *annulipes* and the large chelipeds of which show solid tubercles, especially on the basal parts of the manus. Moreover, the inner edges of pollex and dactyl forming the gape are more or less W-shaped, especially on the pollex, whereas that of the dactyl usually is nearly straight except for 1 or 2 larger teeth. Carapace in this species measured up to 26 × 18 mm. There is one more character which might prove useful in distinguishing the two species in the field: the 'fingers' of the large cheliped (pollex and dactyl) when thought of as in a transverse section are round in *annulipes* and broad and flattened in *marionis nitidus*. As *U. marionis nitidus* apparently shows quite a considerable geographic (and ecologic?) variation it has been referred to in literature under several names, the most important of which are:

Uca marionis (Desmarest) f. *nitidus* (Dana)
Gelasimus marionis Desmarest 1825
Gelasimus cultrimanus Gray 1847
Gelasimus vocans H. Milne-Edwards 1852
Gelasimus nitidus Dana 1852
Gelasimus marionis var. *nitidus* Alcock 1900
Gelasimus marionis Alcock 1900
Gelasimus marionis Tweedie 1937
Gelasimus marionis nitidus Tweedie 1937
Uca marionis nitidus Tweedie 1950

It should be noted that there is a difference between *U. marionis* and *U. marionis nitidus* in that the W-shaped inner edge of the pollex in *m. nitidus*, is only S-shaped in *marionis*. Both forms live side by side in some places, and it is still open to discussion by systematists whether they can and should be put under the one heading of *U. marionis*. If for the sake of brevity only *U. marionis* is used in what follows, it must be understood that *U. m. nitidus* is meant.

C. 1. The Fiddler Crabs of Bandra, Bombay, and their Biotope

To get an idea of population density the holes in 5 areas of 4 sq. meters each were counted. There was an average of 36 holes per sq. meter, and thus an average distance from one hole to the other of about 17 cm. Of course, in some especially crowded places the holes were as close together as about 5 cm. It may well be asked how an individual crab manages to recognize its own hole in such crowded situations—if there is such a thing as 'ownership' of holes at all. Also how the problem of distributing and maintaining the feeding areas is handled, which, after all must have a certain size. The entrance to the holes was flat (fig. 7), and no parapets or 'funnels' around the entrance could be seen (as are, for instance, built by *U. pugilator*, J. Dembowsky 1926, J. Crane 1941). All holes which I opened up ended in the ground water and thus the inhabitant could get down to the water to wet its gills. The average depth of the holes was some 30-50 cm., and the deepest burrow I dug out went as far down as 95 cm. This particular hole was the farthest removed from the bulk of the population, and situated on a fairly dry sandy spot among some big stones. Possibly several occupants had contributed their share of building activity to it in the course of time, and dug it deeper and deeper. The area under observation consisted of a sandy mud-flat which fell dry at every low tide.

Some temperature figures may give a better idea of the biotope: on 27-5-1953 at 12.00 hours the calm water near the shore was 38°C. about 5 cm. beneath the surface. An isolated small lagoon of approximately 1 sq. meter in size and with a maximal depth of about 10 cm. averaged 39.3°C., and the dark mud measured 40°C. at the surface. In and about the lagoon both *Uca*-species were quite actively engaged in feeding and fighting, and did not seem to suffer from the heat at all. In the holes, about 5 cm. beneath the surface, the temperatures were (average of 10 holes on 2-6-1953): 30.5°C. at about 9.00 hours; 34.1°C. at 11.00 and 36.4°C. at 13.00 hours. I could not record a higher temperature under the same conditions in any hole, though I took quite a number of temperatures on days which I thought to be hotter. It is a remarkable fact that in the tropics a number of specialized animals live quite close to the temperature-limit their organism can stand, and a small increase in temperature would mean certain death to many of them. J. Verwey tried to find out what the temperature-limit for *U. signatus* was and found that 5 *signatus* could stand atmospheric temperatures in their cages at 40.6°C. for 1 hour. However, it does not necessarily mean that the *Ucas* standing these atmospheric and environmental temperatures are as hot as those figures. This was shown fairly clearly by experiments carried out on Bandra beach which I briefly summarize here:

On 31-5-1953 I exposed 4 *marionis* (2♀♀ and 2♂♂) of approximately the same body-size (carapace 19 × 16 mm.) to direct sun radiation by keeping them in small glass jars, open on top and preventing the animals to move. The temperature was measured by inserting the thermo-needle into the buccal cavity of the animals and recording every 30 seconds. I do not give all details here, but the final result only. After half an hour of sun-exposure, during which the atmospheric temperature in the (hottest) jar had risen from 35.0 to 39.8°C. the buccal-temperature of the 'hottest' animal was only 35.5°C., in which no increase could be noted during the next 15 minutes. So, the animal being still fairly far from getting its proteins irresistably denaturated by high temperatures one should be careful in stating possible causes for the death of *Ucas* at atmospheric temperatures of about 41°C. or more, as apparently the animals are still considerably cooler at this point provided they do not suffer or die from lack of water (which, of course, means asphyxiation). The only way of getting exact information about the upper temperature-limit of *Uca* seems to be heating them to death in gradually warmed up water—though this procedure is certainly non-Indian in its attitude and not liked by me, either.

The main enemies of *Uca* in my place of observation seemed to be the Indian House Crow (*Corvus splendens*), the Cattle Egret (*Bubulcus ibis*), and the Paddy Bird (*Ardeola grayii*). According to Humayun Abdulali (verbal information) one of the keenest enemies of *Uca* is the Whimbrel (*Numenius phaeopus*), the long beak of which is ideally suited for catching the crabs when out of their holes when they promptly autotomize their big claw to leave it as a sort of scapegoat in the bill of the enemy while themselves trying to escape to safety. The bird, however,—possibly by individual learning from experience —is usually seen to discard the big claw immediately and to seize the escaping crab forthwith.

It is interesting to note, that a man approaching the *Uca*-bank in an erect posture, sends the crabs scurrying into their holes at a distance of about 8-10 meters. Birds of the first three species mentioned give the same effect if flying over the field at a height of up to 10 meters. Birds at higher altitudes and planes going over to land at the nearby Santa Cruz airport produced no alarm among the crabs. In rushing down their holes due to a possible enemy, the males usually were the first to enter, followed by the females and the young ones. I never saw an adult male being caught by a crow, which of course can happen, but apparently does less frequently than with females. In this respect adult males seem to be more on the alert. The above notes indicate that vision, probably, is fairly highly developed in *Uca*, though no experiments on colour- or form-perception have been carried out up till now. It may be mentioned that a passing shadow, even if moved quickly on and off a certain individual, had no effect at all provided the object casting the shadow was well beyond the alarm-limit. This could easily be shown by waving one's hand when just before sunset the shadows were so lengthened that the moving hand could stay clearly out of the alarm-zone of the crab concerned. This behaviour again indicates the probably good visual acuity of fiddler crabs which in *U. pugnax* has been found to be 3.87° by L. B. Clark (1935) using optomotoric methods.

The average length of time between rushing down before an enemy and emerging again to look around was about 30 secs. for the males of marionis (I have noted only these), provided one stayed perfectly quiet after setting the alarming effect. Sometimes the emergence after the flight is not done stealthily after peeping out of the hole 'with one eye', so to say, but by a rapid movement of the whole body which propels the crab right up to the mouth of the hole whence it darts down again, if there is still any danger.

C. 2. Feeding

About 5 minutes after the tide had left, the first individuals of both species emerged from their holes. Usually the males were the last ones to appear. Mud and dirt were removed from the eye-stalks and chelipeds. Usually the minor cheliped was used to pick the mud particles off the eye-stalks and major cheliped, but sometimes the eye-stalks were simply drawn through the slightly hairy gape of the minor cheliped and cleaned this way. After a short time of building activity, which was confined to clearing the entrance of the burrow from possible mud deposits and to removing a few 'handfuls' of mud from the hole, a definite period of feeding began. Small particles of the muddy soil were taken from the surface with both chelipeds (in the females) or with the minor cheliped only (in the males) and conveyed to the mouthparts. It is by no means clear which parts of the mud—whether minute algae or bacteria etc.—are the essential food of the crabs. Also there is still a lot of guessing about the feeding procedure and the function of the various mouthparts in *Uca* (cf. J. Verwey and J. Crane). What could easily be seen with the naked eye was that at certain intervals small pellets of rejected material were deposited on the left or right side of the crab's body by using the minor cheliped. The crab advancing slowly when feeding leaves behind more or less straight lines of these pellets which begin at the entrance of the hole each time the crab takes up feeding again after a possible flight into its hole. Thus fairly geometric radiation patterns are sometimes formed (fig. 8). Counting the frequency of feeding movements, i.e. movements of the cheliped from the ground to the mouth, in *marionis* resulted in an average of 18 movements per 10 secs. in the females and in 15 per 10 secs. in the males, which, of course, can eat with only one 'hand'. In doing such counts it is important to note that the frequency of the movements varies apparently with the intensity of appetite and on the toughness and texture of the mud to be broken into small 'handfuls' by the chelipeds. The male handicap of having only one hand for feeding against the two 'spoons' of the female seems to be countered by the fact that the male small claw apparently brings more food per feeding movement than the female claw. This was suggested by a closer scrutiny of the motion-pictures taken of feeding *Ucas*. Here the time during which the claw is in contact with the mouthparts is longer in the males and definitely shorter in the females, indicating that time is saved in the males by gripping a fair lot of mud each time the claw takes food from the soil.

As the shape of the spoontipped hairs on the merus of the second maxilliped is very probably typical for each species or at least species-group, these interesting structures of both species are shown in figs. 9, 10 and 11. Measurements taken microscopically of hairs from specimens of varying body-size showed that there is hardly any evidence to support the view that species-individuals with a large body-size might take larger particles of mud (or sift larger pieces out of the mud) by means of the spoontipped hairs than do smaller individuals. A few figures of the measurements taken may give an idea of the correlation of carapace-size and width of 'spoon' of these hairs: average width of spoons was 0.046 mm. in *marionis* specimens of 13 × 8 mm. carapace-size, and 0.069 mm. in individuals of 27 × 17.5 mm.; in *annulipes* of 8 × 4.5 mm. the spoons were 0.032 mm., and 0.046 mm. in specimens of 15 × 11 mm. So the spoon-size varies only by about 1-2/100 mm. even between these extreme variants of body-size. Thus, the function of the spoon-tipped hairs remains open for further investigation; maybe they serve as a sort of sieve for removing the water from the material, or some other purpose still unknown.

C. 3. Waving, Fighting, 'Territory' and Copulation

There is hardly any serious fighting or waving during the first feeding period after the tide has gone. Occasionally two males will exchange a few beats with their great chelipeds if they have approached each other too closely when following their feeding-paths. The first full waving occurred between 21 and 38 minutes after the water had receded. Timing the frequency of waving movements by means of a stop-watch has not too much sense as it varies with the intensity of display and action-specific energy. Thus my first countings on 20 large specimens of *marionis* averaged 1 waving movement per every 4 seconds. Countings on a fairly large number of individuals finally showed that the shortest time from one waving to the next one was somewhat shorter than 1 sec. And the film-scenes taken on 24 full waving movements revealed that the shortest interval between two wavings is 12 frames with the 16 frames/sec.-speed—which means $\frac{3}{4}$ sec. Thus, observation in the field and evaluation of the film-scenes gave nearly the same figure, indicating that *U. marionis* waves at $\frac{3}{4}$ sec. at its best (in May-June). Whether there may be an increase in waving-frequency during a different time of the year is not yet known, and open to observation by Indian biologists. Apparently, however, May-June is part of the breeding season, as quite a number of ovigerous females were seen.

The temporal and spatial components of the waving movement in *U. marionis*, as revealed by the movie-camera, are shown in fig. 12, which was drawn after the film. A brief description may serve as further clarification of the process: From the resting position on the ground—in front of the crab's body—the big claw is gradually and comparatively slowly (see the time scale in fig. 12) raised towards an upward-outward position. During this part of the waving process the animal's body is more and more raised towards an 'on toes'-tip position' and the small claw is also brought straight upwards. When this climax is reached, a very sharp quick down-beat of both claws in an inward-downward direction follows, at the end of which the original resting position with great claw on ground in front of the crab is restored. This sharp down-beat—especially, of course, of the great claw—is quite conspicuous, as it gives a very quick and definite impression after the somewhat slow and 'hesitating' upwards lifting. Thus it is this part of the waving movement in *marionis*, that gives one really the impression of a beckoning or 'Come on!' gesture. Moreover, it is this down-beat beckoning that seems to be the constant factor in the otherwise varying movement of waving, as in 21 (out of 24) scenes it lasts 2/16 seconds each. Thus the down-beat lasts about $\frac{1}{8}$ second, whereas the upward-on-toes' tip- and claw-outward movement varies from $\frac{3}{4}$ to a few seconds. I do not know very much as yet about the details of waving in the smaller species *U. annulipes* as I did not take any motion-pictures. These, however, are necessary for a precise analysis since the naked eye is too subjective an instrument for observation of such quick and complicated happenings as the 'waving' of fiddler crabs. What can be said is that in *annulipes* the waving cheliped is usually brought into a definitely more lateral-outward position than in *marionis*, and that by this characteristic one can tell the species. A similar difference in this outward flexion of the great cheliped was to be seen between very large and small specimens of *marionis*. As the extremely large individuals of this species had aroused my interest for reasons of allometric growth and allied phenomena, I paid special attention to 4 very large *marionis* males and labelled them. Thus I could shadow them and watch (and partly film) their type of waving for 5 days. Never during this time did I see that these 'monster' specimens waved in the normal manner of medium-sized and smaller individuals. The waving frequency of these 'big four' was sometimes at its peak (at intervals of $\frac{3}{4}$ sec.), but the outward flexion angle of their large cheliped never was as great as in specimens of average dimensions. This difference in outward flexion angle of the great claw is possibly due to the well-known fact (see J. S. Huxley *et al.* 1931, J. S. Huxley and F. S. Callow 1933) that with increasing body-size the male great claw of *Uca* tends to become disproportionately large and—what is more important in regard to waving—*heavy*. The growth-center of this positive allometry of the great claw is situated in the propodit of the great cheliped, and thus the center of gravity is more and more shifted towards rather distal parts of the crab's body. How

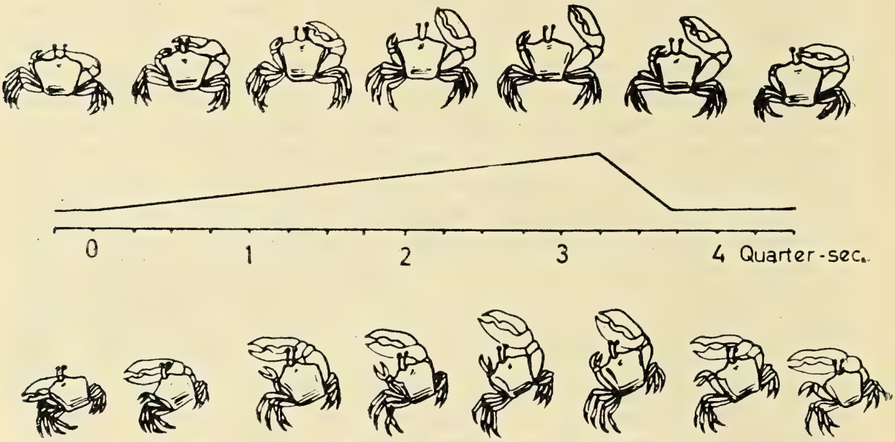

FIG. 12 Waving movement in *Uca marionis nitidus*: its temporal and spatial components in relation to the time-scale (after motion-pictures).

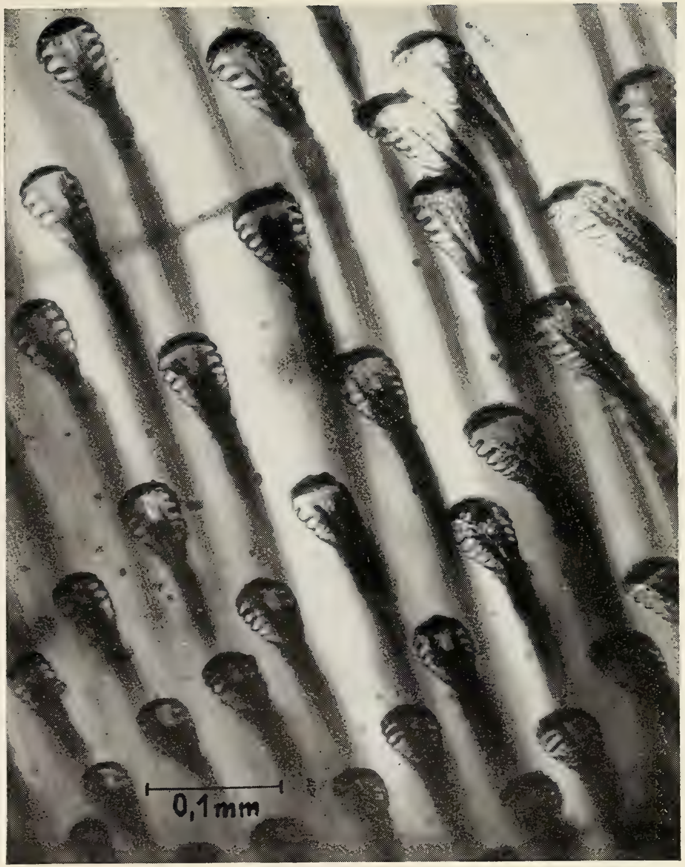

Fig 11. Spoontipped hairs in natural arrangement in *Uca annulipes.*

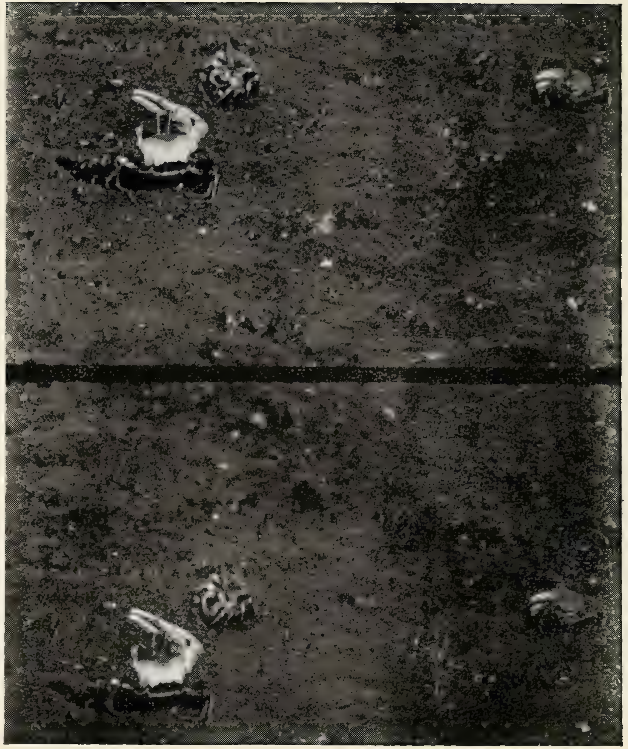

Fig. 13. Male of *Uca marionis nitidus* in display colouration waving at (feeding) female (from a 16 mm-motion-picture).

far this state of 'overbalance' (J. S. Huxley *et al.* 1931, p. 329) can go may be seen from some data of my table of weights (Table 1):

Table 1. Marked positive allometry of weight of major cheliped in relation to body-weight in *Uca marionis nitidus* (Nos. 8-17) and *U. annulipes* (Nos. 1-7).

No.	Total body weight g	Weight of major cheliped g
1	0·22	0·05
2	0·23	0·06
3	0·35	0·14
4	0·45	0·15
5	0·55	0·18
6	1·40	0 35
7	1·60	0 53
8	2·40	0 87
9	3·30	1·06
10	3 35	1·07
11	3·90	1·65
12	3 92	1·57
13	7·00	2·61
14	7·18	2·66
15	7·30	2·75
16	7.33	2·69
17	7·40	3·56

In a *marionis* ♂ with a total weight of 7.40 g. the large cheliped weighs 3.56 g. Thus nearly half the total weight is made up by the large claw, and hence it seems comprehensible that such a heavy structure cannot be waved the same way as a lighter one could. The final stage of a marked positive allometry here seems to have a direct bearing on the type of waving. A similar situation shows up between the waving-type of *U. signatus* and *U. consobrinus* DeMan (Verwey 1930). In the smaller species *U. consobrinus* the large cheliped is brought into a much more lateral position at the peak of the waving movement than in the larger *U. signatus*. Verwey thinks of morphological differences in the chelipeds as the causing factor, but weight and balance may also play quite an important role in this problem.

Except during the periods of feeding and building, after and before high tide, waving was sure to occur when a female was seen by a male (fig. 13). Sometimes a male would also wave towards another male, if the latter's back was turned towards him and his large cheliped hidden from view. This fact supports Verweys' suggestion that the visual perception of form is so well developed in *Uca* that the males recognize the females from the absence of the large cheliped. Quite frequently one could see that a waving male turned his back towards the 'target' waved at. This can be done because the spatial angle of binocular vision is somewhat like 180° (L. B. Clark 1935 and W. v. Buddenbrock 1944) so that there is no spatial limit of vision towards the rear of the animal. Once I watched a dancing male, his back facing 'his' female—who, as usual, continued to feed! He danced around her in a circle of about 2 ft. diameter, and repeated this circle a full five times. Then a crow crossed the scene at about 3 meters above the ground which sent all other fiddlers down the holes in a rush. This particular male, however, remained outside and stood in a sort of stiff position with both claws rigidly stretched up and outwards for some 15 secs. ('threatening position', see below). I never saw any female respond to the sometimes frantic waving efforts of the males, nor have former authors done so. Great as the stimulus of the female's presence may be to the male's waving activity—since waving frequency is usually increased by her proximity—the female herself takes no apparent interest in his display.

The threatening gesture as described above with both chelipeds stretched laterally upwards and body lifted on tip-toe could be seen quite often if two males approached each other too closely. This posture was sometimes maintained for as long as 20 secs. The females of *U. marionis* too showed the same threatening posture. Pearse and Crane have also seen females threatening in this manner in *U. pugnax* Smith, while Verwey and Hediger in their reports on *U. consobrinus*, *signatus* and *tangeri* express the opinion that there is no female threatening as the females 'ne possedes pas d'armes efficaces' (1933 *a*, p. 256).

The fighting of the males has been described in detail by Verwey, Crane and others, and my observations on the two Indian species concerned cannot report anything additional, so that the reader is referred to these authors.

Fighting, however, has not yet been reported in the females of *U. marionis* and *annulipes*, and some authors think that female *Ucas* in general do not fight at all. If two females of my Indian species approached each other, they would (except during the feeding and building period) take the typical threatening posture for a short while with body lifted tip-toe, and then strike out with some rapid and apparently fairly strong blows with the first 2 or 3 legs of one side, sometimes aided by the claw of the same side for beating. The flight of the weaker opponent ends the fight, which is the same thing as in the fights of the males. I have never seen a fight between a male and a female (one more indication of the probably good recognition of sexes).

The question of the 'meaning' of the waving habit and its function, then, must—at least as regards my two Indian species—be answered by an inquiry into the sense of territory. If waving is a means of demarcating territory, then it should be shown that a particular male sticks to his burrow for a longer time than just for an occasional visit or for one high tide. If there is no such more or less permanent attachment to the hole, then waving must be interpreted as belonging to the pattern of display and courtship.

Shadowing and following the paths of my labelled individuals showed me quite convincingly that in both species there was no true sense of territory. From one high tide to the next one I found that labelled animals had travelled as far as 14 meters, as their new hole was that far away from the hole last occupied.

I plainly saw that labelled males 'migrate' 6-10 meters from 'their' holes waving, fighting and even rendering 'help' in building at clearly foreign holes *en passant.* Moreover, when caused to flee in alarm, the fiddlers often would not run towards a certain hole, but take to any sufficiently closeby; sometimes a big specimen would try to get down a hole which happened to be too small for him so that part of him remained outside. Possibly, some American fiddlers, even in alarm-flight try to reach a certain (and always the same) hole.

Thus, I must state that in *U. marionis* and *annulipes* waving has nothing to do with a sense of territory, and may imply a bearing on courtship and display. As a direct response by the females to this type of male display has rarely or never been seen by investigators (including me) many problems remain to be solved in this respect. However, one single copulation seems sufficient for the insemination of several spawnings (H. Balss, 1927).

Equally small is our knowledge as regards the normal pattern of copulation. Pearse (1914) has seen 5 copulations of *U. pugilator* in the laboratory, and in 1930 Verwey stated that the authors 'do not seem to have seen any copulations under natural conditions, though fiddler crabs are so frequently to be seen; maybe, copulation takes place in the holes'. Since then, Crane (1941) has watched 5 copulations in *U. stylifera*, *beebei* and *stenodactyla*, but nevertheless she thinks it probable 'that copulation usually takes place in the burrow of the male' (p. 157), since the holes dug by the females are usually too small in diameter. I was fortunate enough to witness 2 copulations of *U. marionis* which happened on the same afternoon, 29-5-1953, at about 18.00 hrs. with a 20-minute interval between the two. Apparently there was no waving specially 'aimed at' the relevant female, but in both cases there was a rapid flight of the female due to chasing by the male, covering about 50 and 80 cm. and—in one case—ending at about 20 cm.'s distance from my feet. (The fiddler had never before approached me so closely even when I kept perfectly quiet.) The males got hold of the females by gripping them from the side, catching their legs first and using the big claw as a forceps. Then, by 'handling' the females with their ambulatories and—mainly—their big claw, the males turned the females 'face to face', so that the ventral sides were facing each other. A quiet interval followed during which copulation took place and which lasted 6 and 8 minutes respectively. During this quiet phase the big claw of the male rested on top of the female's 'forehead', so that both her eyestalks were at first kept down and only one could later be raised into the normal erect position. There was some gentle stroking by the males with their ambulatories. After the partners had separated, both of them started feeding immediately without taking any further notice of each other. In both cases I caught the partners to take their carapace measurements: ♂1 19 × 13.5, ♀1 15 × 10 mm.; and ♂2 18 × 12, ♀2 14 × 10 mm.

Comparing the type of copulation observed by me with Crane's description of the process in the American species mentioned above, there are some similarities: the same position, the same gentle stroking, and the same quiescent period. The differences in the American species described are: There was no use at all of the big claw in catching the female partner; during the quiescent phase the big claw was definitely held free from any contact with the female partner; the longest time of copulation was only 3 mins.

One cannot as yet tell whether the few copulations seen in *Uca* up to now, do represent the normal type of mating, and more information is urgently wanted. Nevertheless, a brief glance at some observations of crustacean copulation cited in literature may be useful, especially as it gives a sort of frame-work to the 'forced' copulation observed by me: In *Astacus fluviatilis*, the European crayfish, 'for copulation the male seizes the female with his "scissors" (chelipeds), turns her forcibly and sheds his seminal fluid' (W. Dröscher, 1906). According to G. Brandes (1897) the male of *Galathea strigosa* uses his claws to seize the female for mating, and of *Eupagurus prideauxii* quite a similar habit is reported, the claws always being used as forceps to get hold of the female. True, all these cases deal with *Astacura*, in which only the spermatophore has to be fixed to the female telson, and in a brachyuran, like *Uca*, internal insemination has to be accomplished, but the similarity of the cases cited from the literature and my own observations seems worthwhile to be mentioned. C. Darwin's conjecture that 'the main purpose of it (of the large cheliped) probably is to seize and hold the female' (1871, p. 297) is proved to be correct from my experience at least in *U. marionis*, though besides this there may be another type of mating behaviour in this and the other species.

C. 4. Burrow digging

Seen as a whole, the population of a *Uca*-bank will show that after the periods of feeding and waving-fighting-(evtl.), copulating—the preparation of holes for the next tide is commenced which ends in the closing of the holes by their inhabitants from within. During this phase of digging burrows a newly increased feeding activity is to be noted. There are reports by Pearse, Dembowsky, Verwey and Crane on the technique applied by *Uca* in digging holes, and principally the same habit as described by these authors could be observed in my two Indian species as well—using the first 2 or 3 ambulatories of the side of the small claw to hold and transport the mud-balls taken from the interior of the hole, the small claw being used as an additional hand for properly 'embracing' the mud-balls.

After the hole had been dug to a sufficient depth *marionis* and *annulipes* would get down and close their holes from inside by pushing up a plug of moist soil, taken from the interior, upwards into the entrance. This plug is kept in place, because the edges surrounding the entrance have usually been specially prepared by the crab. Before going down for the tidal duration the animal takes a sort of riding position on the edge of the hole, left legs and claw on the inside (within the entrance) and right legs and claw on the outside of the hole (or vice versa). Then, moving in circles around the entrance in this 'riding' position the crab drags the mud of the edge centripetally, so that the diameter of the opening becomes progressively narrower. During these riding circles the crab's body gradually spirals down the hole, so that through the smallest diameter of the final opening only some legs are out and to be seen. This final opening then is plugged the way described above, the prepared edges of wet mud supporting the plug. Possibly this 'preparation' of the edges in our two species may have something in common with the habit of building 'funnels' and similar superstructures in some other *Uca*-species as described by Pearse and Verwey, and by Cowles (1908) in *Ocypode arenaria.*

The time between closing the hole by the last *Uca* out and the arrival of high tide covering the bank was a minimum of 30 minutes and a maximum of 45 minutes. This shows that fiddlers 'know' about the arrival of the water beforehand, this 'knowledge', of course, being only the human aspect of a tidal rhythm by which the relevant periods of activity (i.e. opening the hole, feeding, fighting-waving-courting, digging, and closing the hole) are synchronized with the course of high and low tide (see Brown and co-workers 1949, 1951, 1953).

How complicated the situation in *Uca* is, in spite of this concept of tidal rhythms, may however be seen from a few notes in my diary: One afternoon the water had left the *Uca*-bank at 18.00 hrs., but no fiddler appeared, since at 19.15 hours it would be getting dark already. So the crabs 'knew' that there was no use coming out of their holes though the tide was getting low. There were several days, however, when at 19 hours the whole observation area was crowded with feeding and digging *Ucas,* so that there can be no question as to 19 hours being too late a time for the crabs' daily activity. No *Ucas* were out when I visited the place during two nights with full moonlight and clear skies at about 2 a.m., this finding being in accord with Crane's observations, but in contrast to Pearse, who apparently has seen nocturnal activity in *Ucas.*

D. SUMMARY

1. The paper contains a study of the behaviour of the fiddler crabs *Uca marionis nitidus* Dana and *U. annulipes* Latr. in their habitat on the beach near Bandra, Bombay. Biological and ecological factors are taken into account (enemies, temperatures).

2. Marked individuals of both species showed that there is no true sense of territory, and that waving most probably is part of the display pattern.

3. The type of waving (species-specific) in *U. marionis nitidus* was observed, filmed and analyzed by evaluating the motion-pictures. Temporal and spatial components of the waving movement are dealt with in detail. Quickest waving followed at $\frac{3}{4}$ sec.-intervals and was definitely stimulated by the presence of females.

4. In *U. marionis nitidus* there is a threatening gesture in the females also, which is quite similar to the corresponding posture in the males. Threatening and fighting of the females are described.

5. Two copulations in *U. marionis nitidus* (not reported until now of this species, and very rarely of other *Ucas*) could be seen and watched from close quarters. They represent a type of mating behaviour not observed before in *Uca*.

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THE MANAGEMENT OF INDIA'S WILD LIFE SANCTUARIES AND NATIONAL PARKS

BY

E. P. GEE, M.A., C.M.Z.S.

PART II

(*With 4 plates*)

CONTENTS

PAGE

INTRODUCTION 717

STATE WILD LIFE BOARDS 718

ZOOLOGICAL GARDENS, ZOOLOGICAL PARKS, MUNICIPAL PARKS, WILD LIFE SANCTUARIES, AND NATIONAL PARKS 720

SOME POTENTIAL NATIONAL PARKS 722

1. ASSAM 722
2. BENGAL 722
3. MADHYA PRADESH 723
4. MYSORE 723
5. UTTAR PRADESH 723

THE PLANTING OF TREES, AND THE INTRODUCTION OF WILD LIFE FROM OUTSIDE 725

GRAZING OF DOMESTIC CATTLE 726

ADMINISTRATION IN GENERAL 727

OCCASIONAL SHOOTING BY PRIVILEGED PERSONS 728

POACHING 729

CREATION OF NATIONAL PARKS 730

CONCLUSION 732

REFERENCES 732

INTRODUCTION

Since writing the paper 'The Management of India's Wild Life Sanctuaries and National Parks' published in this Society's *Journal* Vol. 51, No. 1 (December 1952), considerable progress has been made in India for the preservation of wild life. The Inaugural Session of the Indian Board for Wild Life was held at Mysore from 25th November to 1st December 1952, and the Resolutions adopted there have been published. Many of these have since been accepted by the Government of India, and some of them are now actually being put into operation.

The Executive Committee of the above Board held its first meeting at Kanha Sanctuary in Madhya Pradesh from 29th October to 2nd November 1953, and the recommendations made by it have been published in *Indian Wild Life Bulletin*, Vol. 1, No. 2 (November 1953).

The writer, moreover, has been able to contact personally many more highly placed people in India and elsewhere directly concerned with preservation of wild life, and he has been able to visit some of the wild life sanctuaries in the States of Mysore, Assam, Bengal, Madhya Pradesh and Uttar Pradesh.

In addition, visits have been made to some of the national parks and other wild life centres of Britain, Switzerland, Kenya, Tanganyika and Uganda; and discussions and exchanges of views have been held with officials concerned with these places.

It is in the light of the developments outlined above that this second paper has been written, as Part II of the previous paper.

State Wild Life Boards

As it was anticipated, the preservation of wild life in India will be mainly, if not entirely, in the hands of the Forest Department, advised by Wild Life Boards. The system of Wild Life Boards has been set up in India, with the Indian Board for Wild Life at the Centre and State Wild Life Boards in the States. By now a number of States have actually created their Wild Life Boards, and it is becoming apparent that the composition of these Boards will need careful consideration.

It is essential that the most suitable persons, both official and non-official, be appointed to sit on these Boards. While the appointment of officials would naturally be by virtue of their official position as heads of the Departments concerned, or their deputies, the selection of non-officials is more complicated.

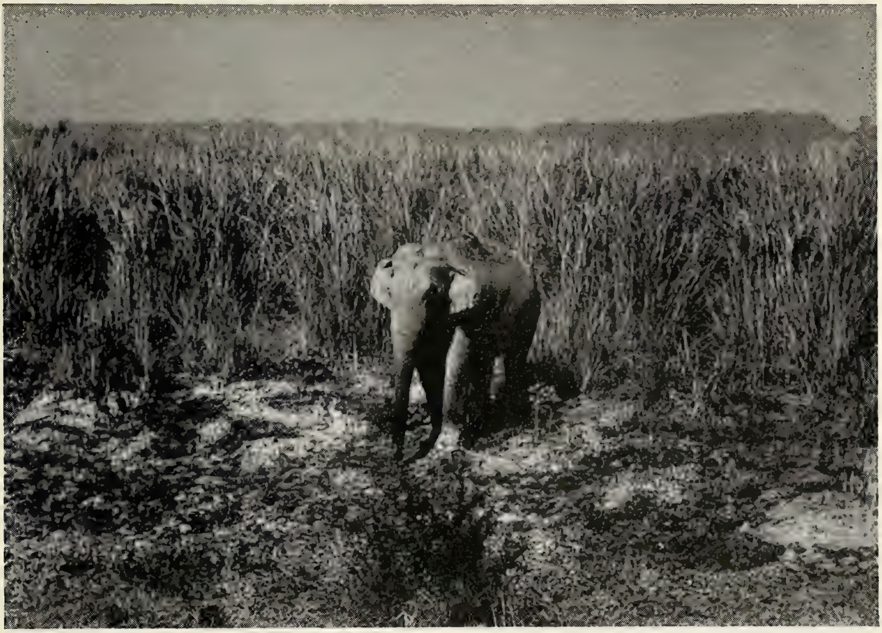
The actual wording of the Mysore resolution on the subject, No. 3, (*a*), reads as follows: 'That each State Government should be requested to set up a State Wild Life Board consisting of representatives of various organisations and interests to deal with the day-to-day administration of local wild life problems'. The word 'representatives' should be carefully noted. It is most important that the non-official members of such Boards should not just be nominated by a Minister or Chief Conservator of Forests, but should actually represent natural history or wild life societies and interests, sporting organisations and interests, publicity interests, public opinion and so forth.

In order that persons may effectively represent their respective organisations and interests, they must obviously be chosen by those organisations and interests themselves. A Note on this subject was carefully compiled by the writer and published in the *Indian Forester*, Vol. 79, No. 10 (October 1953), and the relevant extract therefrom is reproduced herewith:

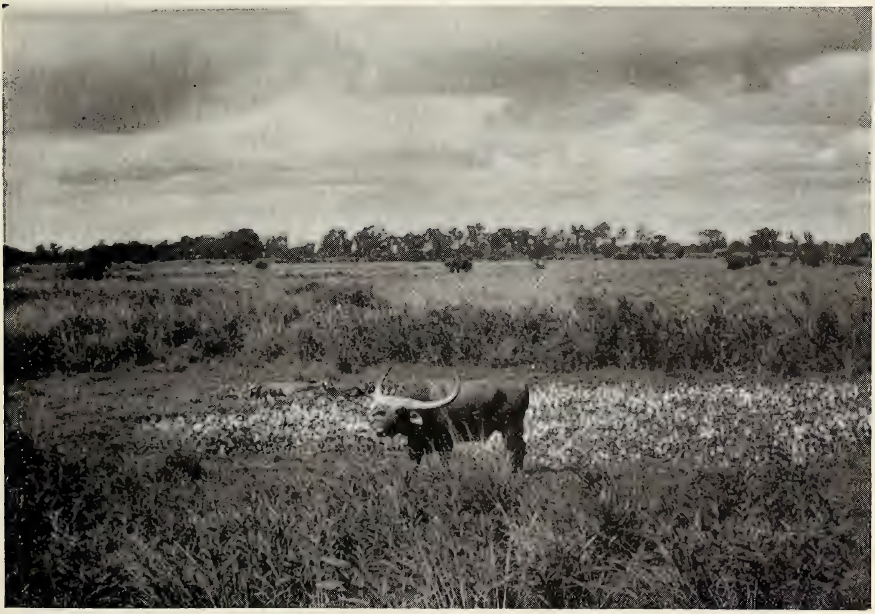
'4. *Non-official Members.*—(i) While the choice of official members should prove comparatively simple and straightforward on the lines indicated above, the appointment of non-official members will require careful consideration.

(ii) One or two influential and knowledgeable M.L.A.s who could "put it across" in the Assembly and on the platform, would be a great asset to any State Wild Life Board. But it is essential that the Board as a whole should steer clear of politics. All shades of public opinion should be represented on the Board. The overriding consideration should be to include knowledgeable persons who can bring an independent outlook to bear on all problems relating to wild life, irrespective of their political affiliations.

(iii) Most important of the non-officials to be appointed would be one or two persons of proved experience and knowledge of wild life problems and wild life conservation. Without such

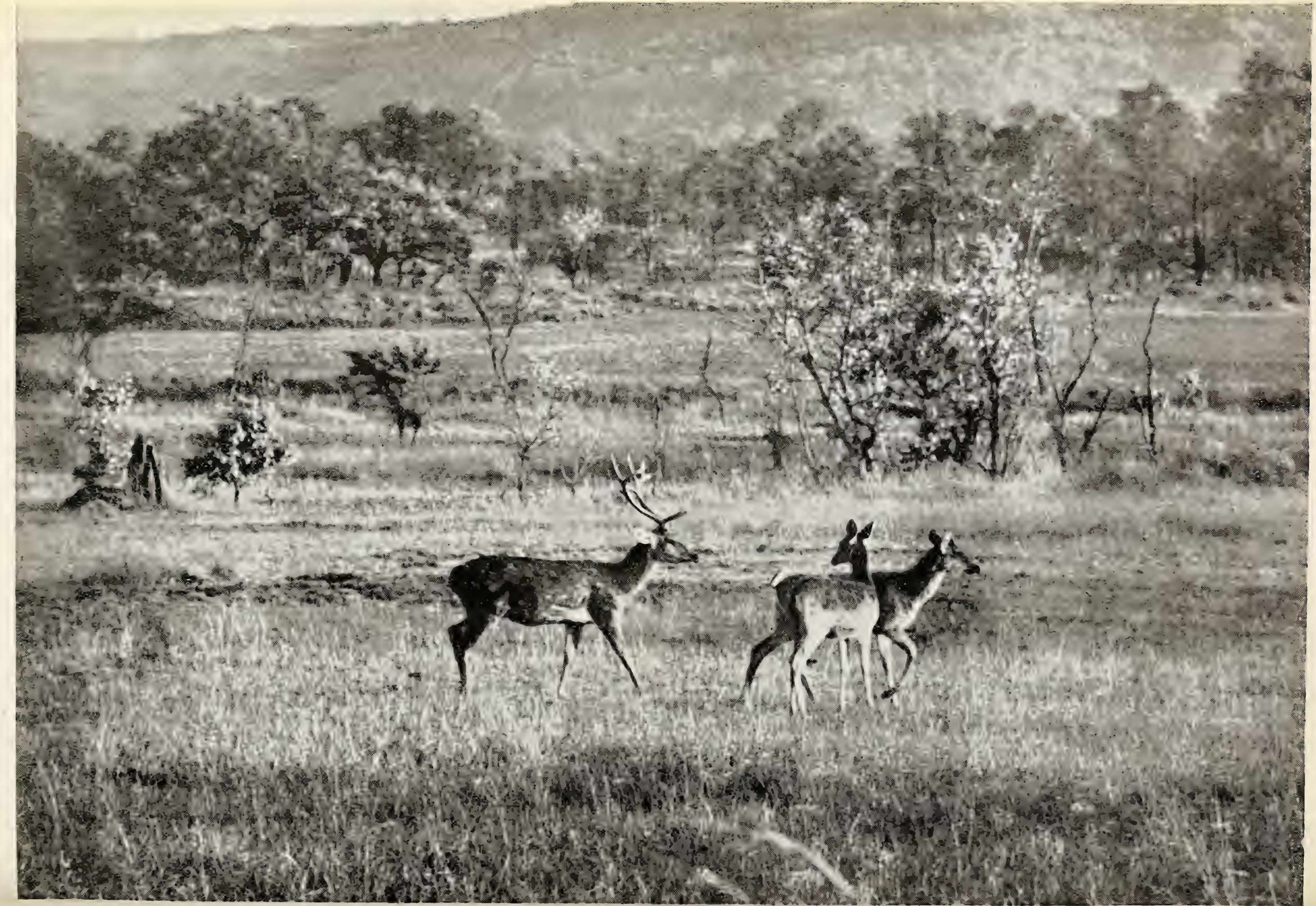


Wild elephant *(makna)*. Kaziranga Sanctuary



Wild buffalo bull. Kaziranga Sanctuary

(Photos : E. P. Gee)



persons a Board will be of little use. Field naturalists are preferable to museum or laboratory specialists; and if a qualified zoologist is chosen he should be a person of practical field experience rather than textbook knowledge. The claims of wild life conservationists of repute should never be overlooked in the composition of a State Wild Life Board; and the appointment of such persons could well be placed in the hands of the Head of the State or of the Executive Committee of the Indian Board for Wild Life.

(iv) Any important organization or interest connected with the study of natural history should be considered for membership. Most States have some kind of natural history society, or at least a nucleus of members of the all-India society known as the Bombay Natural History Society; and from these a representative should be nominated by the Society's committee of management.

(v) Similarly any important game association in a State should be invited to nominate its representative, as the interests of bona-fide sportsmen must always be safeguarded in any scheme for the preservation of wild life. It is well known that the presence of sportsmen in a forest is always a deterrent to poachers.

5. *Other Relevant Points.*—(i) In the event of a State possessing some outstanding Wild Life Sanctuary or National Park, preference should be given to persons residing in that locality when appointing either official or non-official members. Local knowledge and local influence are of paramount importance in such cases.

(ii) In any event members of the Board should, as far as possible, be drawn from different parts of the State concerned. A predominance of members from some particular part or parts of a State would be unfair.

(iii) Another possible asset as a member of a State Wild Life Board might be some influential leader, or someone of great eminence and authority, whose backing in wild life preservation would be of the greatest moral value. Similarly the proprietor or editor of a newspaper in general circulation throughout the State would be a valuable member of any State Wild Life Board.

(iv) If it is considered desirable to admit as large a number of non-official persons as possible to a State Wild Life Board, so as to obtain a wider cross-section of opinion and advice, the Board would become unwieldy. Two methods of overcoming this unwieldiness might be: (*a*) to have an 'Inner' or 'Executive Committee' in control of a larger Board, and (*b*) to have 'Associate' or 'Corresponding Members' in different parts of the State, who would have an opportunity of expressing their views on any important questions in writing, without actually being on the Board.

(v) It is possible that high-ranking ex-officials retired from service, with inside experience of the legal and administrative difficulties, would be suitable for membership—especially if they were also knowledgeable wild life conservationists or experienced sportsmen.

(vi) Some States may already have an appointment for a Game Warden (as in Travancore-Cochin) or Wild Life Officer. In such cases this official would naturally be on the Board.

(vii) The Government of India have recently appointed 'Honorary Regional Secretaries for the Indian Board for Wild Life' for each region of India. These persons are ready to advise States in the matter of the creation of State Wild Life Boards, and to do everything possible to help in the preservation of wild life. They are to 'maintain liaison between the Central Board and the State Boards'. It would perhaps be right, therefore, that the Honorary Regional Secretary should be an honorary or *ex-officio* member of the State Boards within his jurisdiction, and should attend meetings if and when possible. In any case the agenda and minutes of every meeting should always be sent to him.

(viii) The above-mentioned methods of obtaining the best possible representation from the public for the non-official membership of State Wild Life Boards should also be a guide to the appointing of Advisory or Managing Boards or Committees, or Trustees, for any National Parks which might be created in a State.

6. *Conclusion.* The members, both official and non-official, of a State Wild Life Board or National Park Committee have a heavy responsibility to shoulder. For in all cases they will be examining problems and making recommendations for legislation, not to solve the difficulties of the present moment but to ensure that wild life will be preserved for all time.

The wild life of a State and the areas in which it is found will be entrusted to their stewardship, to provide for the public enjoyment of them in such a way that they will remain unimpaired for the enjoyment of future generations.'

ZOOLOGICAL GARDENS, ZOOLOGICAL PARKS, MUNICIPAL PARKS, WILD LIFE SANCTUARIES AND NATIONAL PARKS

There still exists in certain quarters in India some doubt as to the exact character and functions of the various types of park found in the world. It would not be out of place, therefore, to deal briefly with this subject.

1. Zoological Gardens are usually places where as large a number of the world's mammals, birds, reptiles, fish, etc. as possible are on show to the public in as small an area as possible, say 30 to 150 acres. These animals are usually kept in cages or restricted to small enclosures. The functions of zoological gardens are to show animals to the public as conveniently as possible for their recreation and education, and to provide material for scientific study. Zoological gardens are museums of living animals. They are usually found only in the largest cities, as their maintenance depends largely on gate money, or municipal or State grant. They are usually managed by a Board of Management or Trustees for a municipality or for a country, or by a Zoological Society consisting of subscription-paying members.

2. Zoological Parks are usually places where a selection of the world's mammals, birds, etc. are maintained in an environment as far as possible similar to their natural habitat, in a larger area, say 300 to 600 acres or more. The animals and birds are kept in

open fields or small wooded glades or lakes; and it is the human visitors who are restricted to fenced roadways and paths. They are usually outside, but not far distant from large cities, as they also largely depend on gate money for their maintenance.

In both zoological gardens and zoological parks it is more important to have a high standard of maintenance than to have a large collection of animals, i.e. the number of animals exhibited should not exceed the financial resources of an institution.

3. Municipal (or People's) Parks are usually man-made parks in towns and cities of any size, without any animals or birds necessarily being kept in them. Facilities are often provided in these for recreation, especially for children. Trees and plants of any species from any place can be planted in zoological gardens, zoological parks and municipal parks.

4. Wild Life Sanctuaries are usually places where some rare wild indigenous animals and birds, or wild life in good numbers and representative of a region, are considered to be in need of full protection together with their natural environment. Sanctuaries in India are created by the Forest Departments of States, by Gazette Notifications. They can therefore be altered or abolished in a similar manner. As most of the wild life sanctuaries of India are situated in the Reserved Forests where the felling of timber takes place according to a working plan, some sanctuaries have been hitherto wholly or partly exploited for their forest produce, while the wild life is left undisturbed as far as possible.

It is recommended by the Indian Board for Wild Life, and it is obviously desirable, that there should be as little disturbance to wild life as possible. For this reason it is recommended that there should be inner sanctuaries within a sanctuary 'where such operations may not be carried out, to ensure the nursing up of wild life undisturbed by human activities. Such sacrosanct areas may be declared as *Abhayaranya*, i.e. a forest where animals could roam about without fear of man. Such a sanctuary within a sanctuary would also ensure the preservation of plant life unspoiled and undisturbed.'—Mysore Resolution No. 6 (*b*), Note 2.

5. National Parks are usually places which are the same as really good wild life sanctuaries, with this difference: they are created by an Act of the Legislature and therefore they have a permanent status which can only be altered or undone by a subsequent act of the same Legislature. The definition of a national park for India as carefully phrased at the Mysore Conference is: 'An area dedicated by statute for all time, to conserve the scenery and natural and historical objects of national significance, to conserve wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations, with such modifications as local conditions may demand',—Mysore Resolution No. 6 (a), Note.

The up-grading of the best existing wild life sanctuaries of India into national parks by State Legislatures as soon as possible would bring the following advantages: (*a*) These sanctuaries would become permanent intead of temporary strongholds of wild life, (*b*) They would be more effectively administrated, (*c*) They would become more respected by the public, and poaching would decrease, (*d*) They would have an enhanced status, and would become institutions of national importance, (*e*) They would possess a national and all-India significance instead of merely a local one, (*f*) They would receive publicity and attract visitors and tourists from abroad and (*g*) They may become eligible for receiving some financial assistance from the Centre, whenever such assistance is possible.

SOME POTENTIAL NATIONAL PARKS

The following wild life sanctuaries, all actual or potential national parks of India, were visited by the writer since the previous paper was written, and observations were made as under:

1. Assam. Some harmful shooting by 'sportsmen' and poachers had been going on round the fringes of Kaziranga Sanctuary, and sometimes actually inside the boundaries. The relevant resolution at the Mysore Conference, No. 19, reads: 'That buffer belts of sufficient width be declared around all sanctuaries within which no shooting, other than that required for legitimate crop protection, will be permitted . . . .' The State Government by a Gazette Notification has duly created such a buffer zone round the four sides of Kaziranga, and the decrease in poaching has been significant and encouraging.

With regard to the North Kamrup (Manas) Sanctuary, a proposal has been put forward for a similar sanctuary to be made by the Bhutan Government on their side of the border. It is understood that this proposal is receiving favourable consideration in Bhutan. Should such a sanctuary materialise, and should a co-ordinated inter-State sanctuary or national park be created by India and Bhutan, it will be one of the finest in the world for scenery and fauna combined.

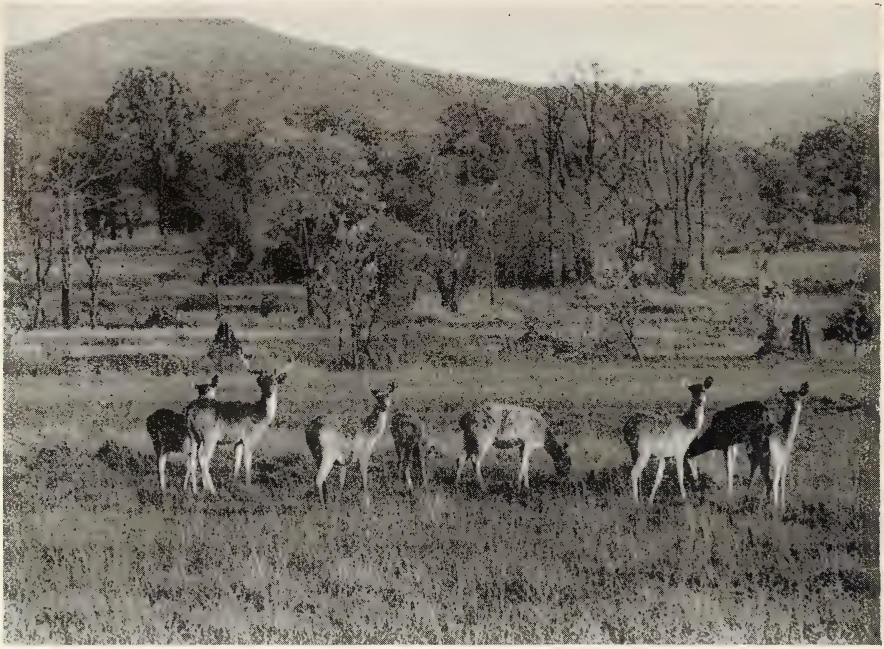
An 'Assam National Parks Bill' is in the process of being drafted for the purpose of up-grading both Kaziranga and North Kamrup Sanctuaries into national parks.

2. Bengal. The writer was able to pay a brief visit to the Jaldapara Sanctuary in North Bengal in April 1953, and again in April 1954. Although a few rhino and deer were observed, the forest, undergrowth and reeds were found to be extremely thick and the animals difficult to find—even on elephant-back after the annual burning. It might therefore be advantageous to the Bengal Government not to create this place as a national park but simply to maintain it as a carefully protected sanctuary, and to seek some other locality for development as a national park and show-place for the public and for tourists from abroad.

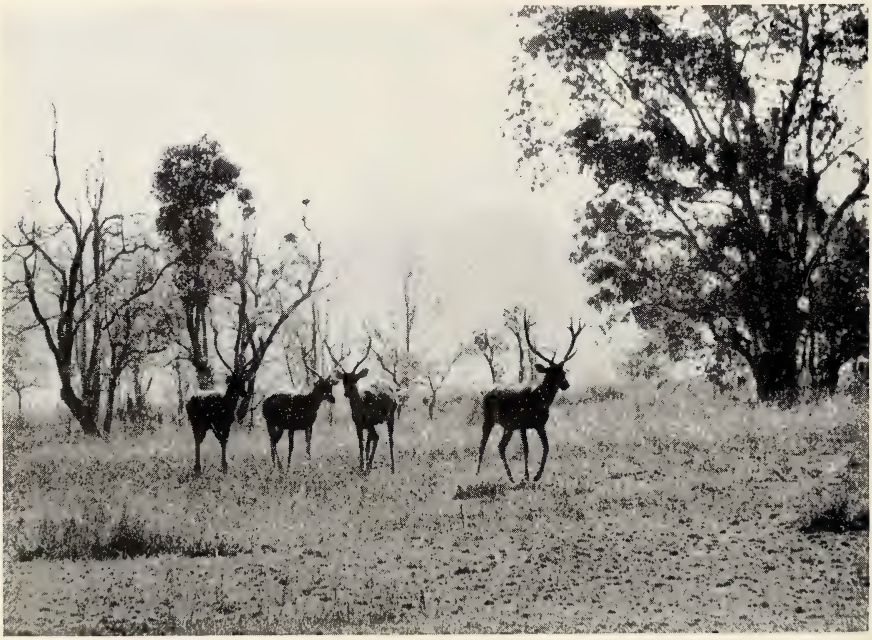
Jaldapara could be much improved as a sanctuary if the burning off of all grassy areas could be done more regularly and more thoroughly. The addition of the rhino area of Cooch Behar in the south would be advantageous; and the creation of a buffer belt, in which

One of the *maidans* in Kanha Sanctuary, Madhya Pradesh

Chital stag *(Axis axis)* in *sal* forest, Kanha Sanctuary
(Photos : E. P. Gee)



Barasinga or Swamp Deer. Master stag and hinds.
Kanha Sanctuary, Madhya Pradesh



Barasinga Stags. Kanha Sanctuary
(Photos : E. P. Gee)

all shooting other than for genuine crop protection was prohibited, would help to preserve the valuable rhino and other wild life.

3. Madhya Pradesh. Two visits were paid by the writer to Kanha Sanctuary, probably better known as the Banjar Valley Reserve. In the first visit from 29th October to 2nd November 1953 this fine sanctuary was seen in its green freshness before the *maidans* had become dried up and burned off. Reminiscent of English parkland it appeared to the writer as one of the most pleasant spots of India. The *sal* and other trees growing in small woods and as isolated trees throughout the *maidans* possess a distinctive natural beauty of their own which no kind of regular planting by man can equal.

The second visit from 17th to 25th April 1954 showed Kanha after the *maidans* had been burned off and the new grass was just beginning to show. The wild life was much more visible during this visit, and the fine Indian Swamp Deer for which this sanctuary is renowned were much in evidence. One can motor all over these *maidans*, as in Africa, though their extent probably does not exceed two square miles. Though the freshness of November had gone with the advent of the hot weather, it seems that February to June must be the best time to visit this beautiful place—the later the better.

This is one of the best potential national parks of India, provided that good access roads can be made, the forest village at Kanha removed or kept under stricter control and a few of the difficulties caused by its remoteness overcome.

4. Mysore. Bandipur Sanctuary, the 'sanctum sanctorum' of the Venugopal Wild Life Park, was visited twice by the writer during the Mysore Conference. It is probably unique in India as being the only sanctuary with numerous motorable roads—there are over 90 miles of them in an area of only 22 square miles. The 'bison' or gaur were to be seen in good numbers, and the writer was close to a herd of 34 of these fine beasts for a whole hour on elephant-back. The Kuruba trackers who locate the wild animals for visitors, thus saving considerable time, are a great asset to this sanctuary, which also contains wild elephant and sambar as well as chital. Tigers appear to have become very rare, and should be allowed to re-establish themselves.

This should become one of the premier national parks of India, especially if one or two small areas of forest could be cleared as 'view points', to enable visitors to obtain unobstructed views of the Nilgiri Hills—thus adding beautiful scenery to the attractions of the place.

5. Uttar Pradesh. The Hailey National Park was visited from 6th to 15th April 1954. The natural beauty and vivid colour of this region in the foothills of the Himalayas actually exceeded expectations, even after reading the descriptions written by E. A. Smythies and F. W. Champion. The view northwards from the Dhikala Forest Rest House was very fine, especially to one coming from the plains. This is perhaps the best part of the Park, and it

occurred to the writer that the hills seen in this view, which are mostly in the Mandal Shooting Block, should obviously be included in the Park instead of being left outside it. If Dhikala is to be the show-place and 'centre' for visitors, it is reasonable to expect it to be well inside the Park and not just on the extreme northern boundary. The valley of the river Ramganga, moreover, with its fishing, *shisham*-covered islands and pleasant *maidans* could very advantageously be included in the Park. All shooting in this 'no-man's-land' should be strictly prohibited so that the wild life of the Dhikala area may become less shy and increase in numbers.

As at Kanha, one of the beauties of this place is the trees, growing naturally throughout the *maidans*. These consist of *sal*, *Bauhinia*, *kusum*, *dhak*, and so on. This natural beauty is one which cannot be equalled by any regular planting of trees in avenues or lines by the hand of man.

One of the greatest assets of the Park is the Ramganga, which is not only a very beautiful river but also provides good fishing for sportsmen from February to May.

The chital I found to be very shy, especially in the region of Dhikala—the show-place of the area. At Boksar they were slightly less shy, and still less so at Paterpani. But even at this latter place they were far more timid than at Kanha Sanctuary. The forest was full of wild life—tiger, sambar, barking deer, elephant, peafowl, junglefowl and others; and of these the tiger is the greatest asset.

It would considerably improve the Park as a sanctuary for wild life if all felling of trees and such operations by contractors, as well as all grazing by domestic cattle, were to be prohibited in the immediate vicinity of the places to which visitors will go, such as Dhikala, Boksar, Paterpani, Sarapduli, Bijrani, etc. If Dhikala is to be the main centre of the Park, then all forest exploitation and undesirable human activity within a radius of at least two miles should be prohibited, thus providing the 'inner sanctuary' recommended at the Mysore Conference.

It is a great drawback to this Park that it falls under the control of two different Divisional Forest Officers, those of Kalagarh in the west and Ramnagar in the east. Visitors, moreover, are at present obliged to apply unnecessarily to two different officers for admission. Obviously the Park would be much more effectively controlled and regulated if it could be made into one administrative unit.

Although this wild and remote but very beautiful national park was created as far back as 1935, no steps appear to have been taken to publicise it or open it up for visitors. The Park is accessible only in the dry months from November to 15th June, for during the monsoon months it has to be totally evacuated—not even a forest guard remains there. The construction of so many roads and bridges for access to the Park and for driving within it during the monsoon would be a formidable task and one involving great expense.

But it should not be difficult to open up this beautiful spot, at least for the serious type of visitor, during the dry season. Accommodation and the other amenities should be provided for the public and for tourists from abroad to attract them, so that they can enjoy the fine scenery, colourful trees, river fishing and above all India's most spectacular wild creature—the tiger.

THE PLANTING OF TREES, AND THE INTRODUCTION OF WILD LIFE FROM OUTSIDE

1. The Planting of Trees

As a national park (or a good wild life sanctuary) is 'An area dedicated . . . to conserve the scenery and natural . . . objects', the planting of trees and shrubs in national parks should be avoided as far as possible. The beauty in the trees on the *maidans* of the Hailey Park and Kanha Sanctuary lies in their wildness and naturalness. Any kind of regular planting of trees in lines or plots immediately reveals the hand of man; it is the beauties of nature, not the works of man, that are looked for in a sanctuary or national park. Forest plantations of trees could be planted along the edges of a sanctuary, as a demarcation of a boundary and as a protection against poachers: this has been tried out with success at Laokhowa in Assam. But in the interior of a sanctuary or national park visitors expect to see and enjoy the natural beauties and wild life in its natural environment, with as little interference by man as possible.

It might, however, in certain cases be advantageous and beneficial to plant a few trees near Forest Rest Houses, hotels, along roadsides or in certain treeless *maidans* in order to improve the scenery and provide shade and shelter for wild life and for man. But in such cases the trees should be planted at random and haphazardly, so as to look as though they were growing naturally. Any kind of straight lines or squares or regular intervals would be quite out of place, and would have the disadvantage of making the place look more like zoological park or municipal park than a wild life sanctuary or national park.

Furthermore, if and when any trees or plants are to be planted in a sanctuary or national park they should be of the indigenous and local species, and never of other species brought in from outside. For the main function of sanctuaries and national parks is to conserve the country's indigenous flora and fauna in their unspoiled state. There is nothing which could spoil a wild life sanctuary or national park in India so much as the planting of, say, mango or blue gum trees in a place where no such trees exist in their wild state.

In the event of new roads being constructed in a sanctuary or national park, advantage should always be taken of the ground so that good views of wild life on both sides can be obtained. Furthermore, such roads should never be straight: winding roads have the advantage of not only being more natural but also they act as a check on possible fast driving by inconsiderate motorists.

2. The Introduction of Wild Life from Outside into a sanctuary or national park is also a thing to be rigidly guarded against, unless in the most exceptional circumstances and under expert advice. In any case the introduction of foreign or exotic species

is a most dangerous and unnecessary thing, in all cases to be avoided. For in a sanctuary or national park the emphasis is always on the indigenous fana. A national park in India would not be truly national in character if it held, say, zebra or giraffe imported from Africa.

But the re-introduction into a sanctuary or national park of a mammal or bird, etc. which has previously existed in that region but which has become extinct, would not only be a beneficial action but also a laudable one—provided it is done on the advice of expert naturalists. It is hoped, for example, that the rare Indian lion of Saurashtra can be re-introduced into some sanctuary or national park of some other State in India, within its former range and under suitable conditions of environment.

Grazing of Domestic Cattle

With regard to this problem, the Indian Board for Wild Life has made the following recommendation: 'Whereas cattle-borne diseases are spread in such sanctuaries by domestic cattle from the surrounding areas, the Central Board for Wild Life recommends that buffer belts of sufficient width be declared around all sanctuaries within which no shooting, other than that required for legitimate crop protection, will be permitted, and within which no professional graziers will be allowed to establish their cattle-pens. Whereas many preventable cattle-borne diseases among herbivorous wild animals result from contact with infected domestic cattle in the neighbourhood of "forests", the Central Board for Wild Life recommends that State Governments be requested to inoculate systematically and periodically domestic cattle in the neighbourhood of national parks, sanctuaries and reserves where and when necessary.'—Mysore Resolutions Nos. 19 and 20.

It cannot be over-emphasised that the grazing of domestic cattle in and near sanctuaries and national parks is not only detrimental to the grazing potential of the area, but is also a positive danger on account of diseases. There are innumerable cases of valuable wild animals dying wholesale from epidemics spread by domestic cattle and buffaloes. In Kaziranga Sanctuary of Assam, for example, many rhino died in 1944 and in 1947, presumably from anthrax; and some wild buffalo died in 1952 from rinderpest, and in 1953 from haemorrhagic septicemia. As many as 150 wild elephants are believed to have died in the Reserved Forests of the North Cachar Hills in Assam in 1949 from anthrax. The 'Indian bison' or gaur have become scarce in many places in north-east India and south India due to cattle-borne diseases.

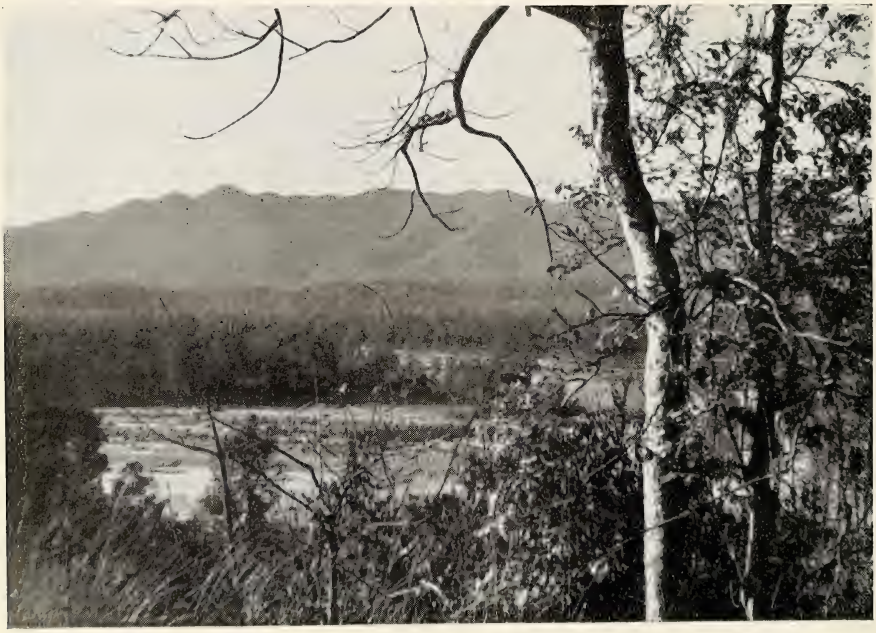
In the Hailey National Park, moreover, I was informed that there were severe outbreaks of rinderpest in 1942 and 1947, in which countless chital are reported to have perished, and probably hog deer, barking deer and sambar as well.

The difficulties of the problem of how to prevent graziers from entering an area where they have done so for many years are fully realized; but all wild life conservationists without any exception

A herd of Gaur *(Bibos gaurus)*. Bandipur Wild Life Sanctuary, Mysore

Young bull Gaur, Bandipur Sanctuary, Mysore
(Photos : E. P. Gee)

Forest Rest House, Dhikala. Hailey National Park, Uttar Pradesh



View across Ramganga River from above rest house.
Himalayan foothills in distance
(Photos : E. P. Gee)

throughout the world are agreed that the grazing of domestic animals inside a sanctuary or national park should be prevented at all costs, and grazing in the surrounding areas reduced to a minimum. In any case all cattle in or near a sanctuary or national park should be regularly inoculated, after which no further cattle should be admitted into the area.

There is a further reason why such grazing by domestic cattle should be avoided: the very presence of domestic animals at the centre or show-place of a sanctuary, where a visitor expects to see wild life, is a veritable eyesore. It is sufficient to spoil the natural beauty of any place, thus rendering anybody's visit a waste of time and money.

Such visitors often travel great distances at great expense in order to see a country's wild life in its natural habitat; and to imagine their surprise, disappointment and revulsion at seeing domestic cattle in such places should not be difficult.

From every point of view, therefore, domestic animals should never, under any circumstances, be allowed at the 'centres' or show-places of a sanctuary or national park, should be prevented from entering the fringes, and reduced as far as possible in the buffer belts and surrounding areas.

Administration in General

There is a tendency in some parts of India to 'lay on' really good preparations when a very important person is due to visit a wild life sanctuary or national park; while at other times, when nobody 'of importance' is due to come, the administration of the place is on vastly different level. The writer has visited several wild life centres in several States of India in the company of v.i.p.s, and then at other times by himself as an ordinary member of the public, and the standard of administration has been found to be startlingly different.

Even the Conservators and Deputy Conservators of the Forest Department usually arrange their tours well in advance, so that the forest staff in charge have ample time to 'prepare' the place. At other times, as it has been found by the writer, there are many occurrences,—commissions and omissions which go undetected—unless reported by non-officials to higher authority.

While it is admitted that v.i.p.s are usually extremely busy men, and that there should be no hitch or delay in the preparations for their visit to a place, it is surely wrong that they should see a place entirely different from what it really is. The actual standard of maintenance of a sanctuary or national park, i.e. the prevention of grazing, trespassing, poaching and the condition of roads, bridges, bungalows, etc. should be of a fixed uniform standard throughout the year, instead of the standard being extremely high during the visit of the v.i.p. or Conservator, and sometimes extremely low at other times. If a place were to be maintained at a uniform level throughout the year, as far as is consistent with the provision of staff and funds, then all visitors, both v.i.p. and ordinary members of the public, would see and enjoy it equally, as it really is and under conditions which one would expect to find in a true democracy.

OCCASIONAL SHOOTING BY PRIVILEGED PERSONS

It has sometimes in the past been the practice in certain sanctuaries in India for v.i.p.s or senior officers of the Forest Department to shoot, say, a deer 'for the pot'. By all the principles and laws of wild life conservation this is a mistake of the greatest magnitude. In the Mysore Resolution No. 6 (*b*) Note 1, it is clearly stated that: 'The expression "wild life sanctuary" shall denote an area constituted by the competent authority in which killing, hunting, shooting or capturing of any species of bird or animal is prohibited except by or under the control of the highest authority in the department responsible for the management of the sanctuary'.

The real reason for this strict rule is not far to seek. It is not because there will be any upset in the balance of nature by the shooting of one chital or such animal, but because by shooting a mammal or bird in a sanctuary the very principle of sanctity is violated and the rules of a sanctuary broken by a highly placed person, while the lower grade forest staff are supposed to obey the rules and enforce them against poachers.

Provision is made in the above quoted Resolution for 'the highest authority in the department responsible for the management of the sanctuary' to exercise control over 'elements adverse to the maintenance of wild life including destruction of vermin and predators'—Mysore Resolution No. 6 (b), Note 3. Under this clause the 'highest authority' could authorise reduction in the numbers of hoofed animals or carnivora if considered advisable, to be done departmentally under strict supervision, and not by any individual at random.

Obviously if, say, a Conservator shot a chital in a sanctuary for his dinner, then in his absence the D.F.O. would feel entitled to do the same; and similarly the R.O., the B.O. and finally the newest-enrolled Forest Guard or Game Watcher would find it hard to resist the temptation. And how would the poachers react to all this?

It is realized that forest officers, in Uttar Pradesh for example, spend long periods on tour in camps in the forest, far away from their homes and the amenities of bazaars and shops. But in such cases, the shooting of a deer or a bird 'for the pot' should invariably be done in an adjacent shooting block, and under no circumstances whatever inside the boundaries of a sanctuary or national park.

It is not the intention of the writer to attempt to advocate the ultra-strict and highly idealistic rules and academic principles of such institutions as the Swiss National Park or the Parc National Albert in the Belgian Congo, for as Keith Caldwell has rightly pointed out, 'one of the dangers to wild life is the out-and-out protectionist'. Rather the writer advocates for India a sound broadminded policy in regard to her sanctuaries and national parks.

It should be emphasised that, in order to enforce the rules of a sanctuary and to prevent all illegal shooting, and in order to ensure the loyalty and integrity of the subordinate staff, v.i.p.s and senior officers of the department concerned should themselves in all cases be model examples in observing scrupulously the absolute sanctity of the wild life entrusted to their care.

In a tour of some of the national parks and national game reserves of East Africa, the writer recently found that even in these vast areas where countless thousands of antelopes and game birds abound, and where lions and other carnivora were making their kills every day all over the place, the very idea of shooting a single creature 'for the pot' was considered utterly abhorrent.

The Park Warden of the Serengeti National Park, in fact, told the writer that even in the old days when the Serengeti was a shooting area a rule was in force debarring all shooting within three miles of the camp, so that wild life could be observed there. And on the occasion of the visit of the Governor to the place on a shooting holiday, as they set out the first day the v.i.p. enquired when shooting was to commence. He was respectfully but firmly informed that shooting would start only as soon as they had passed out of the three-mile limit.

If such rules can be observed in parks of such vast extent as those in East Africa, where they range up to 8,069 square miles in area, then surely the smaller wild life centres of India, of which the average is only about 100 square miles, should be maintained strictly inviolate and sacrosanct.

Poaching

With regard to poaching and similar illegal practices, it has been the experience of the writer and many of his friends in India that the Forest Department is a little 'touchy' on this subject when instances are brought to its notice.

When I visit a sanctuary I usually talk to the Range Officer or Beat Officer-in-charge, and sooner or later put the questions: 'Do you have any difficulty with poachers? Is any poaching going on here?' The answers to this enquiry fall broadly into two categories. One is: 'No, sir, this is a sanctuary. How can there be poaching in a sanctuary? ' The other is: 'There is some poaching going on. We are trying our best to stop it.' Obviously the former answer indicates a doubtful or even most unsatisfactory state of affairs, while the latter is almost certainly an accurate and honest statement.

Divisional Forest Officers and even Conservators are also often evasive or non-committal when the subject of poaching is brought up by members of the public. How often the writer and other members of the general public have travelled many miles at great expense and discomfort to visit a sanctuary or Reserved Forest, and when we report a case of poaching—no reply or even ackowledgement is ever received!

If a visitor or member of the public detects a case of poaching or similar malpractice, what is he to do about it? Is he to remain silent? Or is he to take the trouble to note the details and report the incident? Obviously to remain silent is not only to fail in one's duty as a citizen but also actually to render a disservice to the Forest Department. For in remaining silent he is almost conniving at the offence. It is clearly the duty of everyone to assist the Forest Department by noting carefully anything serious that he sees wrong and by reporting it to the appropriate officer as soon as possible.

Why then is it so often the case that in so doing one's duty, no reply—not even an acknowledgement—is ever received? If no acknowledgement is received, the person reporting is led to wonder (*a*) if the report has ever been received, or (*b*) if received, if any action is being taken. In either case a sense of frustration is the result.

Let us face up to facts. Poaching and such malpractices are always with us, even in the best run institutions in the world—even, say, in the Swiss National Park and in the Parc National Albert. The desire to hunt is inborn in all men, since the days of Adam: even Shakespeare was charged with deer stealing in Charlcote Park in Warwickshire.

In order to minimise poaching, for complete elimination would be impracticable, it is obvious that only co-operation between the public and the authorities will produce any real results. The public can co-operate by developing a strong healthy public opinion, and by reporting all cases of malpractice as they occur.

It is recognised throughout the world that the presence of bonafide sportsmen in shooting blocks, and bonafide visitors and naturalists in sanctuaries and national parks is the best deterrent against poaching. It is plainly the duty of such people to assist the authorities at all times and at all places, and it is equally obligatory on the authorities at least to acknowledge such assistance whenever it is rendered.

CREATION OF NATIONAL PARKS

Two interesting facts have emerged from the meeting in New Delhi in 1951 of the Wild Life Sub-Committee, and from the session at Mysore in 1952 of the Indian Board for Wild Life.

Firstly, the problem as to whether the country's wild life should be left under the Forest Department or placed under a separate 'Wild Life Department' has been resolved. It gradually became apparent that whereas it would be ideal to have a separate wild life department such as exists in certain other countries, in the case of India it would be more practical and more expedient to allow wild life to continue to be conserved by the Forest Department under whose jurisdiction for the most part it naturally falls. For most of the country's wild life exists within the reserved forests. In the matter of wild life conservation, of course, the Forest Department of each State will require some additional staff, and will be advised by its State Wild Life Board.

Secondly, it was found necessary to make some concession to the Forest Department as to whether or not forest management and even forest operations could be permitted within a wild life sanctuary or national park. It is improbable that India, or any other country for that matter, could actually agree to suspend or prohibit forest exploitation where it had previously taken place, and thus forego considerable revenue for the sake of creating a national park. On the other hand, if valuable fauna existed in a forested area, it could not be sacrificed without efforts being made to preserve it. Moreover, sub-tropical and tropical forests are not always ideal as wild life sanctuaries or for visitors to enjoy when left in their 'pristine' state, almost impenetrable with tangled creepers, thick undergrowth and decaying trees.

So a compromise was reached in this respect. A wild life sanctuary or national park in India is now preferably to be left undisturbed by human intervention; but in those cases where it is necessary or advisable to allow restricted and carefully controlled forest operations, such human activity is permissible provided that 'inner sanctuaries' or 'preservation plots' of sufficient extent and in suitable areas are demarcated and strictly maintained.

At the first meeting of the Executive Committee of the Indian Board for Wild Life held at Kanha in November 1953, it was decided to recommend that the most important wild life centres of India be created as national parks.—*Indian Wild Life Bulletin*, Vol. I No. 2, November 1953.

Under a Rs. 40,00,000-scheme eighteen such national parks are proposed to be created, of which eleven are to receive priority in the Second Five-Year Plan which is due to be taken up in April 1956. Various States are already believed to be preparing plans and estimates for these.

Here a word of caution would perhaps not be out of place. It would be a mistake for a State to rush into creating a national park without long and careful consideration as to whether a particular place is really worthy of the accepted definition, to be 'dedicated by statute for all time . . . for the enjoyment of future generations'. For example Bombay with commendable zeal created in 1950 the Kanheri National Park of 9 square miles; but it is a place lacking in fine scenery and wild life. With its caves and carvings and close proximity to the city of Bombay, it had the character rather of a people's park or a public monument. The Bombay Government is now believed to be reconsidering the original plans for this place.

It is particularly desirable that the advice of the Central Board for Wild Life should be taken by a State in all matters concerning the creation of a national park, in order that the right courses are adopted and in order to ensure the national character of a park.—Mysore Resolution No. 6, (*a*).

It stands to reason that any wild life sanctuary which has proved its worth and stood the test of time, such as Kanha, Bandipur, and Kaziranga, can safely be created as national parks after carefully drafting a State National Parks Bill and framing the necessary rules and regulations with detailed demarcation of boundaries and so forth. Any wild life sanctuary which has not definitely proved its worth as such, could be improved and developed as a sanctuary before being reconsidered for creation as a national park.

On the other hand any wild life centre which has not been a sanctuary but happens to be on a programme for possible developing as a national park, could first be made into a sanctuary and could be left as such for a trying-out period before being further considered for a national park.

Even before making a place into a sanctuary, due consideration should of course be given to all aspects of the case, i.e. whether the wild life is rare enough, or in sufficient numbers, or properly representative of the region; whether the place is or can be made accessible to visitors; whether the place will be popular with visitors; whether the place can be sufficiently financed and staffed; whether the place can be effectively protected against poachers, and so forth. The case of Manipur could be borne in mind: this State in their zeal for wild life preservation rather hurriedly created the whole of the Logtak Lake area as a sanctuary. I am informed that this State is now planning to reduce the sanctuary quite considerably, on advice received from other quarters.

CONCLUSION

After a visit to the fine but strictly idealistic Swiss National Park, with its adequate funds and high standard of organization, and after hearing and reading of the Parc National Albert in the Belgian Congo, the writer has felt somewhat dismayed at the paucity of funds and laxity of control of some of the wild life sanctuaries in India. And after seeing the abundance of wild animals and birds in an almost 'tame' condition out in the open in the national parks and reserves of Kenya, Tanganyika and Uganda, the writer has felt discouraged at the comparative scarcity of wild life in India, at its nocturnal habits and at the thickness of the forest which it inhabits.

But India possesses several advantages not enjoyed by other countries. India has very fine tree forests, mountain scenery and grand rivers. And many of these are wild life centres of first-rate national park potentiality, holding many interesting and beautiful species of mammals and birds not found elsewhere in the world.

Without doubt India has a unique opportunity of developing sound but broad-minded systems of wild life conservation and national park administration, even improving on those policies and systems evolved in other parts of the world. And with her wild life situated as it is mostly in beautiful tree forests as opposed to bare scrub areas of, say, East Africa, she has the chance of creating and developing some of the finest faunal national parks in the world.

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APPENDIX A

A TABLE SHOWING THE BEST MONTHS OF THE YEAR FOR VISITING KANHA SANCTUARY, MADHYA PRADESH

(Altitude 2000 feet above sea level)

Month	Index *	Weather	Temperature		Remarks
			Max.	Min.	
January ...	3	Fine, cold.	75	30	Grass being burnt off. Some winter showers. Fairly good time.
February ...	4	Fine, cool.	80	45	Grass being burnt off. Good time.
March ...	4	Fine, cool.	85	60	Grass burnt off. Good time.
April ...	5	Fine, warm.	90	65	New grass growing up. Best time.
May ...	5	Fine, warmer.	100	70	Best time.
June ...	4	Fine, hot.	105	75	Best time. Rains start at end of month.
July ...	1	Rains.	100	75	Uncertain. Alright if dry.
August ...	0	Rains.	95	75	Sanctuary unapproachable, except on foot.
September ...	0	Rains.	90	75	Do.
October ..	0	Rains.	85	60	Do.
November ...	1	Fine, cool.	80	45	Grass high. Roads being repaired.
December ...	3	Fine, cold.	70	35	Grass being burnt off. Few winter showers late in the month. Fairly good time.

* Key to Index numbers:
5 Best time of all.
4 Nearly as good.
3 Alright, but less good.
2 Possible, not fully recommended.
1 Just possible at times, not recommended.
0 Impossible, or not allowed, or closed.

Author's note:—The above table is based on information kindly supplied by officers of the Madhya Pradesh Forest Department, and is only meant to be approximate. It would be highly advantageous if similar tables could be prepared for all the wild life centres of India.

APPENDIX B

A TABLE SHOWING THE BEST MONTHS OF THE YEAR FOR VISITING INDIA'S WILD LIFE CENTRES

	N.E.			N.	HIM.	W.		C.	S.			
Month	Kaziranga	North Kamrup	Jaldapara	Hailey Park	Kashmir, Kulu	Gir Forest	Keoladeo Ghana	Kanha	Bandipur	Mudumalai	Periyar Lake	——
January ...	4	5	4	3	0	4	3	3	4	4	5	
February ...	5	5	5	4	0	4	3	4	4	4	5	
March ...	5	5	5	5	1	4	1	4	4	4	5	
April ...	4	3	5	5	4	5	1	5	5	5	4	
May ...	2	2	2	4	5	5	1	5	5	5	4	
June ...	1	0	0	0	5	3	1	4	5	5	3	
July ...	1	0	0	0	5	1	3	1	4	4	2	
August ...	1	0	0	0	5	1	5	0	3	3	2	
September...	1	0	0	0	5	1	5	0	3	3	2	
October ...	2	0	0	0	4	2	5	0	3	3	2	
November ...	3	3	2	0	2	3	3	1	3	3	3	
December ...	4	5	3	2	0	4	3	3	3	3	4	

Key.—5 Best time of all.
4 Nearly as good.
3 Alright, but less good.
2 Possible, but not fully recommended.
1 Just possible at times, not recommended.
0 Impossible, or not allowed, or closed.

Author's note.—The above table is based on information kindly supplied by persons acquainted with local conditions. The factors taken into account are mainly the weather, condition of the roads and the amount of vegetation. When certain access roads are improved, some changes may be made in the above figures, which in any case are only approximate.

THE BIRDS OF GUJARAT

BY

SÁLIM ALI

PART II

(*With one plate*)

(*Continued from p.* 458 *of this volume*)

The families dealt with in this part appear in the following sequence :

- Hirundinidae : Swallows, Martins
- Campephagidae : Cuckoo-Shrikes
- Irenidae : Fairy Bluebirds, Ioras
- Pycnonoidae : Bulbuls
- Muscicapidae :
  - Muscicapinae : Flycatchers
  - Timaliinae : Babblers
  - Sylviinae : Warblers
  - Turdinae : Chats, Robins, Thrushes
- Motacillidae : Wagtails, Pipits
- Laniidae :
  - Laniinae : Shrikes
- Sittidae : Nuthatches, Spotted Creeper
- Paridae : Tits
- Dicaeidae : Flowerpeckers
- Nectariniidae : Sunbirds
- Zosteropidae : White-eyes
- Fringillidae : Buntings, Finches
  - Fringillinae : Rosefinches
- Ploceidae : Weaver Finches (including House Sparrow)
- Sturnidae : Mynas
- Oriolidae : Orioles
- Dicruridae : Drongos
- Corvidae : Crows

Family HIRUNDINIDAE : Swallows, Martins

Riparia paludicola chinensis (J. E. Gray). The Sand Martin

Specimens collected : Gujarat: GS614 ♀, GS615 ♂ 17-12-45 Vaghjipur (Mehsana Dist.).

Elsewhere noted : Gujarat: Dabka (Baroda Dist.)

Measurements :	W	B	Tar.	T
1 ♂	91	7·5	10	38
1 ♀	95	8	11·5	45

A colony of about 50 rather scattered nest-tunnels in the steep vertical bank of Vartak River. The owners were flying in and out of these. One tunnel dug out was 3½ ft. in horizontal depth, with a flimsy pad of straw and a few feathers at the end. It was apparently fresh but empty. The gonads of the specimens were undeveloped.

Hirundo rupestris Scopoli. The Crag Martin.

Specimen collected: Gujarat: SD198 ♂ 6-3-48 Pandwa (Surat Dangs.)

Elsewhere noted: Gujarat: Bodeli (Baroda Dist.); Fort Salher, *ca.* 5000 ft. (Navsari Dist.).

Measurements:	W	B	Tar.	T
1♂	128	12	12	54

Winter visitor. Numbers hawking insects in company with swallows, dusky crag martins and swifts. Somewhat larger size and paler underparts distinguish it in the air from the resident *H. concolor.*

Hirundo concolor concolor Sykes. The Dusky Crag Martin.

Specimens collected: Kutch: KS266 ♂+, KS267♀ 25-9-43 Bhuj. Gujarat: SD148 ♂+ 4-3-48 Pandwa (Surat Dangs).

Measurements:	W	B	Tar.	T
2♂♂	106–110	8·5–10	9–9·5	45–47
1♀	108	9·5	9·5	45

Common. Met with near rock scarps and ruined buildings, ancient forts, etc. hawking winged insects usually in company with swallows and swifts. Both males (March 4 and September 25) had enlarged testes and were breeding. Several nests in occupation were observed in Kutch during August and September.

Hirundo rustica gutturalis Scopoli. The Eastern Swallow.

Specimen collected: Kutch: KS422 ♀, KS423 ♀ 30-3-44 Bhimasar (Anjar Dist.) Gujarat: GS20 ♀, GS21 ♂, GS22 ♂ 29-10-45 Ajwa (Baroda Dist.); GS266 ♂ 17-11-45, GS1050 ♂, GS1051 ♂ 20-3-46 Kharaghoda.

Measurements:	W	B	Tar.	T (central)	T (outer)
3 ♂♂	116–123	11–12	11–13	40	80–90
3 ♀♀	108–117	11·5–12	13	43–55	68–71

On size all the above are *gutturalis,* but Col. Meinertzhagen points out that they have a *broad* black band separating the chestnut from white on the breast, which in true *gutturalis* from East Asia is *narrow.* He would assign the specimens to *H. r. ambigua* described by Stresemann from Sikkin (*Orn. Monatsb.* 1940, p. 88). *Ambigua* is really an intermediate race between *H. r. rustica* and *H. r. gutturalis* and since there is often already considerable difficulty in distinguishing between these two forms, the recognition of an intermediate complicates rather than simplifies the matter! In the case of wintering birds such as the above, I consider it particularly inadvisable to assign them to the intermediate race which Dr. Ripley now synonymises with *gutturalis* (Indian Checklist, MS).

A common winter visitor. Earliest date 27 October; latest 17 April. Both the specimens of 20 March were very fat, in body moult but with the wings freshly moulted, and were obviously preparing to emigrate.

Small flocks and larger gatherings hawking in the neighbourhood of irrigation reservoirs in open country.

Hirundo smithii filifera Stephens. The Wiretailed Swallow.

Specimen collected: Gujarat: GS23 ♀ 29-10-1945 Ajwa (Baroda Dist.).

Measurements:	W	B	Tar.	T. (central)	Wires
1 ♀	119	11·5	11	37	75

Observed in Kutch, Saurashtra and Gujarat, in the neighbourhood of water—irrigation tanks, temple ponds, etc. Breeding was in progress during March and April. A favourite site, both for this swallow and the Large Pied Wagtail, is an overhang of rock flanking a stream, forming a sort of miniature gorge. In such situations, at various times and at different places, I have seen the nests of the two species placed within 2 or 3 feet of each other.

Hirundo fluvicola Blyth. The Cliff Swallow.

Specimens collected: Gujarat: GS24 ♂ 29-10-45, GS58 ♂, GS59 ♀, GS60 ♀ 31-10-45 Ajwa (Baroda Dist.).

Measurements:	W	B	Tar.	T. (central)	T. (outer)
2 ♂♂	93·5–96	9	11	38	44

Undergoing general moult in October.

Resident but local. Usually in moderate numbers where occurring. Rare in Kutch, and presumably also in Saurashtra. Hawks midges in the neighbourhood of water in company with swifts and other swallows. Utters a sharp *trr, trr* in flight.

Hirundo daurica erythropygia Sykes. Sykes's Striated Swallow.

Specimens collected: Kutch: KS9 ♂+ 8-8-43 Rudra Mata (Bhuj Dist.); KS40 ♂+ 11-8-43 Bhuja Fort. Gujarat: GS425 ♂ 29-11-45 Kasari, Cambay; GS267 ♂ 17-11-45 Dabka (Baroda Dist.); SD146 ♀ 4-3-48 Pandwa (Surat Dangs).

Measurements:	W	B	Tar.	T. (central)	T. (outer)
3 ♂♂	109–113	10–10·5	14	42–45·5	73–76·5
2 ♀♀	104–107	10	13–15	45–45·5	71–72

Fairly common resident. Seen in pairs or small parties, not in large flocks like the wintering race *nipalensis*. Breeding freely in Kutch in August/September in retort-shaped nests of mud pellets stuck horizontally to ceilings of rock caves, temples and domes, and crumbling buildings in old forts. A newly-completed nest was also seen under a culvert on Songadh Fort (Navsari Dist.) on 10 April, with the birds working on it. In the flesh, the tarsi are considerably stouter than in *H. rustica*.

Hirundo daurica nipalensis Hodgson. Striated Swallow.

Specimens collected: Saurashtra: B49 ♀ 20-10-43 Dhari (Amreli Dist.); Gujarat: GS761 ♂, GS762 ♀, GS763 ♀, GS764 ♀, GS765 ♀, GS766 ♀, GS767 ♂, GS768 ♂, GS769 ♀, GS770 ♂ 30-12-45 Radhanpur; GS967 ♂, GS968 ♀ date Ghatwad (Kodinar).

Measurements :	W	B	Tar.	T. (central)	T. (outer)
6 ♂♂	115–121	9·5–11	13–15	40–43	65,68,81–107 (1)
7 ♀♀	112–119	9·5–10·5	13–14	37–43	71·5–89

Common in winter in enormous swarms, particularly on arrival in their winter quarters and again shortly before they leave. Packed assemblages of several hundred birds may be seen perched along telegraph wires. One such gathering in Radhanpur occupied three adjacent strands, about a hundred yards long, and must have contained several thousand birds sunning themselves on a cold morning.

Delichon urbica urbica (Linn.) The House Martin.

Specimens collected : Gujarat: GS1238 ♀, GS1239 ♀, GS1240 ♀ 10-4-46 Songadh Fort, *ca.* 1100 ft (Navsari Dist.).

Elsewhere not noted.

Measurements :	W	B	Tar.	T
3 ♀♀	107·5–114	9	12–12·5	51–54

All the above were fat and in general moult prior to emigration.

Not recorded from the area previously. Obviously a winter vagrant, About 50 birds were hawking in company with Redrumped Swallows, Dusky Crag Martins and House Swifts. In flight its diagnostic points are (*a*) white rump as in the House Swift, (*b*) white underparts as in the Wiretailed Swallow, (*c*) short, only slightly forked tail as in the Cliff Swallow.

Family CAMPEPHAGIDE : Cuckoo-Shrikes

Hemipus picatus picatus (Sykes). The Blackbacked Pied Flycatcher-Shrike.

Specimen collected : Gujarat: SD55 ♂ 27-2-48 Malegaon (Surat Dangs).

Elsewhere noted : Waghai (Surat Dangs).

Measurements :	W	B	Tar.	T
1 ♂	64	15	13	58

Resident ? Not common. Occasional pairs in mixed deciduous forest with bamboo, in foothills country, uttering its squeaky whistling *whiririri, whiririri*, etc. Previously recorded from the tableland of Akrani, south of Narbada River, in the adjacent W. Khandesh District (Davidson, *S.F.*, x : 301).

Tephrodornis virgatus sylvicola Jerdon. The Large Malabar Wood Shrike.

Specimen collected : Gujarat: GS1256 ♂ 13-4-1946 Waghai (Surat Dangs).

Elsewhere not noted.

Measurements :	W	B	Tar.	T
1 ♂	118	30	21	82

Iris lemon yellow.

The specimen agrees with birds from Travancore, but has a very large bill, and is also perhaps a bluer grey (against dusky grey) on the lower breast. This may be due to freshness of plumage. 3 ♂♂ (Kanara, Mysore, Travancore) have bills 25–27 mm; 7 ♀♀ 23·5–27 mm.

Stuart Baker (F.B.I., ii: 311) describes the Malabar Wood Shrike as occurring up the western side of the peninsula (W. Ghats) from the extreme south to 'almost Bombay City'. On this Mr. Whistler remarked (*JBNHS*, 36: 338) that he had failed to trace any record more north than the 'jungles west of Belgaum' (Laird). The present considerable extension of range is therefore of especial interest. Waghai is about 130 miles NNW. of Bombay City, *ca.* 21°N × 73°30′ E. Since it lies in the zone where the foothills of the northern extremity of the Sahyadris (W. Ghats) intermingle with those of the western Satpuras, there is good reason to believe that closer investigation will show the Large Wood Shrike to extend right across the peninsula along the Satpura mountain trend, inhabiting enclaves of the appropriate facies of moist deciduous forest scattered here and there, thus linking up *sylvicola* with the other races found in the Visakhapatnam ghats, Bastar, Orissa, Eastern Himalayas, Assam, Burma, Malaysia, etc. It will be remembered that Mr. Whistler was unable to determine the subspecific identity of Visakhapatnam ghats specimens since they did not agree with *pelvica*, the race from Nepal and Darjeeling. A possible explanation is that *sylvicola* grades into *pelvica* along the Satpuras and that Visakhapatnam birds are intermediate. However, specimens since procured by me in Bastar and the Orissa hills are certainly *pelvica*.

The loud and clear quick-repeated *witoo, witoo, witoo, witoo* uttered by the Dangs example sounded in no way different from the call of Travancore birds. The specimen was in freshly-moulted plumage and evidently preparing to breed. Testes 4 x 2 mm.

Tephrodornis pondicerianus pondicerianus (Gmelin). The Indian Common Wood Shrike.

Specimens collected: Kutch: KS53 ♂, KS54 ♀ juv., KS55 ♂ 12-8-1943 Godsar (Bhuj Dist.). Gujarat: GS148 ♂ 6-11-45 Bodeli (Baroda Dist.); GS396 ♂, GS397 ♀ 28-11-45, GS502 o? 7-12-45 Cambay town environs; GS881 ♀, GS882 ♀ 11-1-46 Deesa (Palanpur); GS1236 ♀ 9-4-46 Songadh (Navsari Dist.); SD23 ♀ 25-2-48 Malegaon; SD233 o? 10-3-48 Laochali (Surat Dangs).

Elsewhere noted: Kutch: Chaduva; Bhuj; Mandvi; Mata-no-madh. Gujarat: Pavagadh (Panchmahals Dist.); Ajwa (Baroda Dist.); Vaghjipur and Patan (Mehsana Dist.); Balaram and Gangasagar (Palanpur); Juna Rajpipla and Rajpipla town environs; Galkund (Surat Dangs). Saurashtra: Amreli and Dhari; Dalkhania.

Measurements:	W	B	Tar.	T
4 ♂♂	83–88	20·5–22	19–22	64–69
5 ♀♀	84–89	18·5–22	19–21	59–68

All the above specimens are intermediate between *pondicerianus* and *pallidus* but closer to the former, except the two from Deesa which go better with the pale NW. Indian race *pallidus*.

Resident. Common in Gujarat, less so in Kutch. Nests and other breeding activity were noted chiefly from the last week in February till mid-April.

Coracina novaehollandiae macei (Lesson). The Large Indian Cuckoo Shrike.

Specimens collected: Gujarat: GS78 ♂ 1-11-1945 Ajwa (Baroda Dist.); GS219 ♀ 10-11-45 Jambughoda; GS660 ♂, GS661 ♀ 20-12-45 Vaghjipur (Mehsana Dist.); GS710 ♂ 25-12-45 Patan (Mehsana Dist.); GS840 ♂ 6-1-46 Radhanpur; GS1096 ♂, GS1097 ♀ 25-3-46 Juna Rajpipla; SD240 ♀ 10-3-48 Laochali; SD366 ♂ 18-3-48 Mheskatri; SD405 ♂ 20-3-48 Sarwar; SD418 ♂ 22-3-48 Pimpri (Surat Dangs).

Elsewhere noted: Gujarat: Cambay town environs; Nadiad (Kaira Dist.); Deesa (Palanpur); Dediapada (Rajpipla); Songadh (Navsari Dist.); Waghai and Galkund (Surat Dangs). Absent in Kutch.

Measurements:	W	B	Tar.	T
6 ♂♂	165–169	27·5–31·5	25–27	121–134
4 ♀♀	158–167	26·5–30	25–26·5	121–129

Resident. Fairly common in mixed decidous forest and openly wooded country. Feeds largely on figs of the various wild *Fici* along with other frugivorous bird species. Every time a bird alights on a branch it flicks up first one wing, then the other, repeating this in a way reminiscent of a nervous gentleman constantly tugging at his tie!

Coracina melanoptera sykesi (Strickland). The Blackheaded Cuckoo Shrike.

Specimens collected: Gujarat: GS338 ♂ 20-11-1945, GS347 ♀ 21-11-45 Dabka (Baroda Dist.)

Elsewhere noted: Gujarat: Vaghjipur (Mehsana Dist.)
Absent in Kutch.

Measurements:	W	B	Tar.	T
1 ♂	105	20	22	84
1 ♀	102·5	20	21·5	78

Status uncertain. Rare, but presumably resident though apt to be overlooked in seasons when it is silent. Mr. R. M. Simmons observed it in Ahmedabad from May through August definitely, and records a nest at Abu Road (about 40 miles NW. of Palanpur) on June 20. (*JBNHS*, 47: 735).

Pericrocotus flammeus flammeus (Forster). The Orange Minivet.

Specimens collected: Gujarat; GS1260 ♂, GS1261 ♀ 13-4-1946, GS1265 ♂, GS1266 ♂, GS1267 ♀ 14-4-46 Waghai; GS1304 ♂, GS1035 ♀ 20-4-46 Galkund; SD64 ♂ 28-2-48 Malegaon; SD111 ♂, SD112 ♂, SD113 ♀, SD120 ♂ 2-3-48 Galkund; SD177 ♀ 6-3-48 Pandwa; SD239 ♀ 10-3-48 Laochali; SD298 ♀ 14-3-48 Mahal; SD330 ♂ 16-3-48, SD370 ♂ 18-3-48 Mheskatri; SD400 ♂ 20-3-48 Sarwar; SD447 ♀, SD448 ♀ 24-3-48 Waghai (Surat Dangs).

Elsewhere noted: Gujarat: Medha near Songadh (Navsari Dist.). Not in Kutch or Saurashtra.

Measurements:	W	B	Tar.	T
10 ♂♂ ad.	89–96	17–19	15·5–17·5	82–94
9 ♀♀ ad.	87–91·5	16–18·5	16–17	83–89·5

These specimens represent a considerable extension northward of the range given in F.B.I. (ii: 322) and by H. G. Deignan (*Auk*, 63: 516) for western India, namely Cape Comorin to Khandala. The Tapti River may now be accepted as its northern limit though there is good reason to believe that as in *Hemipus picatus* and a number of other evergreen and moist deciduous forest birds, this minivet extends eastward along the Satpura mountain trend to link up with the recently described *semiruber* of the Visakhapatnam ghats and other eastern races. Following Stresemann, Deignan shows that *semiruber* is really a race of *flammeus*, as is *speciosus* itself under which it was placed by previous authors.

Resident. Common in hilly bamboo and mixed deciduous forest. The February and March specimens were in body moult; April specimens in fresh plumage. Courtship chasing of females by males amongst the treetops was general in the first half of April, though no development of the gonads was as yet noticeable.

Pericrocotus cinnamomeus cinnamomeus (Linn.). The Little Minivet.

Specimens collected: Kutch: KS2 ♂, KS3 ♀ 7-8-1943 Bhuj. Gujarat: GS91 ♀ 1-11-45 Ajwa (Baroda Dist.); GS135 ♂ 5-11-45 Bodeli (Baroda Dist.); GS407 ♂ 28-11-45, GS504 ♂ .7-12-45 Cambay town environs; GS529 ♀ 9-12-45 Nadiad (Kaira Dist.); GS861 ♀ 10-1-46 Deesa (Palanpur); GS1109 ♂, GS1110 ♂ 26-3-46 Rajpipla; SD3 ♂ 23-2-48, SD84 ♂, SD85 ♀ 29-2-48 Malegaon (Surat Dangs).

Elsewhere noted: Kutch: Godsar; Chaduva; Mandvi; Ratnal; Bhachau; Rudra Mata; Jakhau. Gujarat: Kanewal (Cambay); Vaghjipur and Patan (Mehsana Dist.); Radhanpur; Balaram and Gangasagar (Palanpur). Saurashtra: Ghatwad (Kodinar).

Measurements:	W	B	Tar.	T
7 ♂♂	66–71	12·5–14	15·5–18	66–76
4 ♀♀	66–69	13–13·5	16–17·5	68–75

The two Kutch specimens, and the one from Deesa, show passage to *pallidus* chiefly in the slightly paler grey of the upper parts.

In Washington DC. I recently had the opportunity of examining, with the assistance of Mr. H. G. Deignan, good series of these minivets from the U.S. National and other museums, supplemental to the Gujarat Survey collection. We both agreed with Dr. Ripley's action (Indian Checklist, MS.) in synonymising *Pericrocotus peregrinus dharmakumari* Koelz from Junagadh (Saurashtra) with the nominate race.

Resident. Common throughout the area. Several nests in all stages—building, completed, and with eggs or young—were found in Kutch during August and September, chiefly in trees of *Prosopis spicigera* between 6 and 8 feet up. Both sexes build, incubate and tend the young. Three eggs form the normal clutch.

Pericrocotus erythropygius erythropygius (Jerdon). The Whitebellied Minivet.

Specimens collected: Kutch: KS257 ♂, KS258 ♀, KS259 o? juv. 21-9-43 Rapar (Wagad Dist.) Gujarat: GS146 ♂ 6-11-45 Bodeli (Baroda Dist.);

Elsewhere noted: Kutch: Bhuj; Nir and Kala Dongar (Pachham Island).

Measurements :	W	B	Tar.	T
2♂♂	68–70	12·5–13	14–14·5	75·5–87
1♀	69	13	15	moult

Resident : Common in Kutch, though rather patchy and local. The Bodeli specimen is my only record from Gujarat; it was solitary and seemed to be a straggler. Affects more or less semidesert country, stony and broken, with bushes and stunted trees of *Prosopis spicigera*, *Capparis aphylla*, *Salvadora oleoides*, etc. and clumps of Euphorbia. When overhead, the flight is very like a wagtail or bunting's—a few flaps followed by a dipping glide . . . flaps . . . glide, and so on.

The breeding season in Kutch is July, August, September. Family parties of parents with two or three young were commonly on the wing in the two latter months, and a nest with 3 partly-fledged young was found at Rapar on September 21.

Butler (*S.F.* iii : 465) found it rare in N. Gujarat. Once or twice he met small parties in low bush jungle near Deesa.

Family Irenidae : Fairy Bluebirds, Ioras

Aegithina tiphia humei Stuart Baker. The Central Indian Iora.

Specimens collected : Gujarat: GS161 ♀ juv. 7-11-45 Bodeli (Baroda Dist.) GS212 ♂ imm. 10-11-45 Jambughoda ; GS330 ♀ 17-11-45, GS355 ♀ 21-11-45 Dabka (Baroda Dist.) ; GS382 ♂ juv., GS383 ♂ 27-11-45 Cambay ; GS611 ♀ 17-12-45 Vaghjipur (Mehsana Dist.) ; GS723 ♀, GS724 ♂ Patan (Mehsana Dist.) ; GS826 ♀ 4-1-46 Radhanpur ; GS1276 ♂ 16-4-46 Mahal (Surat Dangs). Saurashtra: GS971 ♂ 11-3-46 Ghatwad (Kodinar) ; GS1007 ♀ 15-3-46, GS1022 ♂ 16-3-46 Dalkhania (Amreli Dist.) I have seen a specimen collected in Bhavnagar, Saurashtra, by K. S. Dharmakumarsinhji.

Elsewhere noted : Gujarat: Baroda City ; Pavagadh ; Champaner; Nadiad ; Songadh (Navsari Dist.) ; Deesa (Palanpur) ; Rajpipla; Galkund (Surat Dangs) Absent in Kutch and about Kharaghoda (?)

Measurements :	W	B	Tar.	T
7 ♂♂	64–67	17–20	19–22	45–54·5
6 ♀♀	62–64	15·5–19	18–20·5	48–52

Nuptial moult March/April ; most males in perfect breeding plumage by mid-April. Two of the November specimens immature with imperfectly ossified skulls.

Aegithina nigrolutea (Marshall). Marshall's Iora.

Specimens collected : Kutch: KS20 ♂, KS21 ♀ 9-8-43 Bhujia Fort ; KS114 ♂ 25-8-43 Mandvi ; KS154 ♀ 3-9-43 Nakhatrana ; KS394 ♂ 21-3-44 Godsar (Bhuj Dist.) ; KS418 ♂ 28-3-44 Bela (Great Rann). Gujarat: GS876 ♀, GS877 [♂] 11-1-46 Deesa (Palanpur.)

Elsewhere noted : Kutch: Chaduva ; Anjar ; Bhachau ; Rudra Mata ; Mata-no-Madh ; Lakhpat. Saurashtra : Dhari (Amreli Dist.)—unconfirmed.

Measurements :	W	B	Tar.	T
5 ♂♂	62–65	14–18	17–19	43–47·5
3 ♀♀	61–64	14·5–17	19·5 (1)	45–51

Specimen No. GS877, collected on the same day and in the same locality as GS876 is undoubted *nigrolutea*. It measures W 64, B 18·5, Tar. 19, T 48·5. It has a green tail and matches perfectly an immature male of *Ae. t. humei* in post-juvenal dress from Jambughoda (GS212). Except for somewhat broader greenish white edges to the tertiaries (perceived only on careful examination) it cannot be told from *Ae. t. humei.* If this specimen had been obtained by itself I would have unhesitatingly assigned it to the latter.

In the Eastern Ghats Survey report (*JBNHS,* 35 : 750) Mr. Whistler points out that the juvenal plumage of *Ae. nigrolutea* is unknown. The present specimen suggests that the juvenal plumage is possibly as indistinguishable from that of *Ae. t. humei* as the post-juvenal plumage in this case appears to be. The point needs elucidation.

Ae. tiphia humei is fairly common in the well-watered portions of Gujarat inhabiting cultivated country interspersed with large trees, groves about villages, roadside avenues and wooded compounds in towns, as well as light deciduous forest.

Ae. nigrolutea is common in Kutch to the complete exclusion of *tiphia.* It affects sparse scrub and thorn jungle, so characteristic of that area, and of which kandi (*Prosopis spicigera*), peeloo (*Salvadora oleoides*), khair (*Acacia catechu*), gangi (*Grewia populifolia*) and gugar (*Balsamodendron mukul*) are some of the principal components. The only occasion on which I met it in Gujarat was also in almost identical semidesert facies.

I found the call notes of Marshall's Iora distinct from those of the common species, though of the same general pattern. The sibilant whistles of the male are more plaintive-sounding, and rather reminiscent of the Quaker Babbler. The harsh notes of concern (as when its nest is being handled) recall those of the Wood Shrike, particularly the large *Tephrodornis virgatus.* I found the notes of the two so distinct, in fact, that after having met the Common Iora all through Gujarat, I detected the presence of this species at Deesa at once by ear, and confirmed it soon afterwards by the specimens.

The breeding season in Kutch is from June through August.

Chloropsis aurifrons frontalis (Pelzeln). The Malabar Goldfronted Chloropsis.

Specimens collected : Gujarat: GS1213 ♂ 7-4-46 Medha (Navsari Dist.): GS1249 ♀ 12-4-46, GS1264 ♀ 14-4-46 Waghai (Surat Dangs); GS1291 ♂ Mahal (Surat Dangs)

Measurements:	W	B	Tar.	T
2 ♂♂	97-101	25–26	20-20·5	71-73
2 ♀♀	93·5–94	24	20–21	69–70

Not met with by the Survey north of the Narbada River. Frequent in deciduous forest. Commonly seen probing for nectar into blossoms of *Firmiana colorata*, *Loranthus* spp. and *Woodfordia fruticosa*, Testes of the males showed some development, but breeding had not commenced in April.

Chloropsis cochinchinensis jerdoni (Blyth). Jerdon's Chloropsis.

Specimens collected : Gujarat: GS144 ♂, GS145 ♀ 6-11-45, GS220 ♂ 11-11-45 Bodeli (Baroda Dist.): GS1230 ♂ 9-4-46 Songadh (Navsari Dist.): GS1307 ♂ 20-4-46 Galkund (Surat Dangs).

Elsewhere noted: Gujarat: Pavagadh (Panchmahals Dist.).

Measurements:	W	B	Tar.	T
4 ♂♂	90–94	23–26·5	19–20	73–77
1 ♀	87	23	19	65

Body moult in April. Testes of specimen of 20 April showed a slight development (4 × 2mm) but breeding had not commenced. Frequents somewhat opener country than the Goldfronted species, and met with in large leafy trees standing amidst cultivation and grazing land. Along with sunbirds and white-eyes, amongst the most important cross-pollinators in this area of *Loranthus* flowers.

Pycnonotus jocosus [**fuscicaudata** Gould]. The Red Whiskered Bulbul.

No specimens obtained. A single pair was observed at Waghai in the Surat Dangs, 13-4-10946. Not met with elsewhere in Gujarat or Saurashtra. Absent in Kutch.

Pycnonotus cafer humayuni Deignan. The Central Indian Redvented Bulbul.

Specimens collected: Kutch: KS32 ♀ 10-8-43 Tapkeshwari (Bhuj Dist.). Gujarat: GS353 ♀ 21-11-45, GS354 ♂ Dabka (Baroda Dist.); GS485 ♂ 4-12-45 Golana (Cambay); GS628 ♂, GS629 ♂ 18-12-45 Vaghjipur (Mehsana Dist.); GS1084 ♂ 22-3-46 Kharaghoda; GS1112 o? 26-3-46 Rajpipla.

Elsewhere noted: Gujarat: Baroda; Bodeli; Jambughoda; Ajwa; Pavagadh; Harij (Mehsana Dist.); Radhanpur; Deesa; Palanpur; Ahmedabad; Nadiad; Surat; Waghai; Mahal; Galkund; etc. Saurashtra: Kodinar; Dalkhania; Dwarka; Okha; Morvi; Rajkot, etc. Kutch: Bhuj; Chaduva; Nakhatrana; Bhachau; Rapar; Kala Dongar (Pachham Island); Dhunara; Jakhau; Mata-no-Madh; Dholovira (Khadir Island); Bela.

Measurements:	W	B	Tar.	T
6 ♂♂	92–98	17–19	20·5–23	79–90
1 ♀	92	18	23	78

Birds from south Gujarat [e.g. Dabka (Baroda), Rajpipla, etc.] are darker, with the grey scaling to the feathers of the back and breast narrower. They go better with birds from the neighbourhood of Bombay City which are the southern peninsular Indian race *pusillus* (Blyth) (= *vicinus* Ripley). At Ahmednagar on the Deccan Plateau, in the same latitude as Bombay but about 100 miles to the east and across the ghats, the race, as pointed out by Whistler (*JBNHS*, 35: 755), is *pallidus* (= *humayuni*).

March specimens are undergoing complete moult; November specimens are in fresh plumage. Common throughout the area in every biotope save pure desert (e.g., the Great Rann of Kutch), though present along its edge. An unfailing attendant on the flowers of the wild caper (*Capparis aphylla*), and on banyan and ber (*Zizyphus*) trees with ripening fruit. Usually the most numerous bird species in gatherings on these. A large assemblage was observed roosting in a leafy mango tree in company with Brahminy Mynas (January). Breeding was in full swing in Kutch during August/September.

Pycnonotus leucotis leucotis (Gould). The White-eared Bulbul.

Specimens collected: Gujarat: GS278 ♀, GS279 ♀, GS280 ♀ 18-11-45 Dabka (Baroda Dist.); GS458 ♂ 2-12-45 Golana (Cambay); GS750 ♀ 27-12-45 Patan (Mehsana Dist.); GS 776 ♀, GS777 ♂ 31-12-45 Radhanpur; GS1067 ♂, GS1067 ♀, GS1068 ♂ 21-3-46 Kharaghoda. Kutch: KS8 ♂ 8-8-43 Rudra Mata (Bhuj Dist.).

Elsewhere noted: Kutch: Bhuj and environs; Tapkeshwari; Chaduva; Mandvi; Nakhatrana; Bhachau; Pachham Island; Jakhau; Mata-no-Madh, Khadir Island; Bela Island. Gujarat: Ajwa (Baroda Dist.); Deesa (Palanpur.)

Measurements :	W	B	Tar.	T
6 ♂♂	83–88	15·5–18	21–22	73–80
5 ♀♀	80–87	14–16·5	20–23	73–80

Post nuptial moult in September.

Common over the greater part of the area, but more or less restricted to semidesert tracts. Wherever found side by side with the Redvented Bulbul (e.g., Kutch, Kharaghoda, Radhanpur) its preference for semidesert is readily noticeable. It is abundant in the Capparis-Salvadora facies all along the edge of the Rann. Nectar of *Capparis* blossoms, and berries of *Capparis* and *Salvadora persica* are two of its main food items.

The specimens of 21 September (Kharaghoda) showed some gonadal development. In Kutch, breeding is recorded as commencing in June. It was in progress during August and September.

Pycnonotus luteolus luteolus (Lesson). The Whitebrowed Bulbul.

Specimens collected: Gujarat: GS247 ♂ +, GS248 ♀ +, GS249 ♀ 17-11-45 Dabka (Baroda Dist.); GS498 ♂ 6-12-45 Cambay.

Elsewhere noted: Gujarat: Baroda City and environs; Pavagadh (Panchmahals); Vaghjipur (Mehsana Dist.); Navagam (Rajpipla). Not noted in Saurashtra. Absent in Kutch.

Measurements:	W	B	Tar.	T
2 ♂♂	90–92	19–20	22·5–23·5	85–86
2 ♀♀	88–89	20	24	81–82

These specimens measure somewhat larger than a series from the Eastern Ghats measured by Whistler: 5 ♂♂ W 86·5–90·5; 7 ♀♀ 82–85·5 (*JBNHS*, 35: 759).

Not uncommon locally. Its preferential habitat is scrub jungle in ravines such as obtain near the mouths of the Narbada and Tapti Rivers in Gujarat, and in dry erosion nullahs. A female collected on 17 November was laying. Betham took 2 clutches of eggs at Baroda in June (*JBNHS*, 11: 316).

Family MUSCICAPIDAE

Subfamily MUSCICAPINAE: Flycatchers

Muscicapa striata neumanni Poche. The Eastern Spotted Flycatcher.

Specimens collected: Kutch: KS140 ♂ 1-9-1943, KS178 ♂ 7-9-1943 Bhujia Fort KS170 ♀, KS171 ♀, KS172 ♂ 6-9-1943 Nakhatrana. Saurashtra: B3 ♀ 12-10-43, B17 ♂ 14-10-43 Dwarka (Okhamandal); B52 ♂ 20-10-43 Dhari (Amreli Dist.).

Elsewhere noted : Kutch: Rudra Mata : Tuna; Anjar; Bhachau; Rapar; Chaduva; Dhunara; Khavda. Not met with in Gujarat.

Measurements :	W	B	Tar.	T
6 ♂♂	82–92	12·5–16	13–16	61–65
2 ♀♀	82–85	12·5–16	15–16	62·5–65

All the above were in freshly-moulted plumage and excessively fat—literally ' balls of fat '.

Autumn passage migrant through Kutch and Saurashtra to its winter quarters, presumably in Arabia or Africa. First noted September 1; last October 20. Does not winter in Kutch or Saurashtra, and evidently the return passage in spring is by a different route, by-passing these areas altogether. At the height of passage, between 2nd and 4th week of September, the birds are fairly common. Both in flight and while at rest, this flycatcher is very reminiscent of the Yellowthroated Sparrow (*Gymnorhis xanthocollis*) in the distance.

Muscicapa latirostris Raffles. The Brown Flycatcher.

Specimens collected: Gujarat: GS1228 ♂ 3-4-46 Medha (Navsari Dist.); GS1269 ♂ 14-4-46 Waghai, GS1312 ♀ 21-4-46, Galkund (Surat Dangs).

Elsewhere not noted in Gujarat, nor in Saurashtra or Kutch.

Measurements :	W	B	Tar.	T
2 ♂♂	72–74	14	14–15	47·5–50
1 ♀	71	14	14	47

All in perfect fresh plumage.

Presumably resident. Singly, perched bolt upright, on bare teak and other branches in deciduous forest. Gonads quiescent.

Muscicapa parva parva Bechstein. The European Redbreasted Flycatcher.

Specimens collected: Kutch: KS313 ♂ 3-10-43 Khavda, KS320 ♀ 5-10-43 Kala Dongar (Pachham Island); KS384 ♂, KS385 ♀ 18-3-44 Lakhpat; KS402 ♂ 24-3-44 Chobari (Bhachau Dist.); KS413 ♂ 26-3-44 Dholovira (Khadir Island). Saurashtra: GS1000 ♂ 15-3-46 Dalkhania (Amreli Dist.). Gujarat: GS131 ♂, GS132 ♀ 5-11-45 Bodeli (Baroda Dist.); GS209 ♂ 10-11-45 Jambughoda; GS401 ♂ 28-11-45 Cambay; GS586 o ? 15-12-45 Vaghjipur (Mehsana Dist.); GS1080 ♂ 21-3-46 Kharaghoda.

Elsewhere noted: Kutch: Bhuj; Chaduva; Nanda (near Adesar). Gujarat: Baroda City; Pavagadh (Panchmahals Dist.); Ajwa (Baroda Dist.); Nadiad town and environs; Patan (Mehsana Dist.); Radhanpur; Gangasagar (Palanpur); Rajpila town and environs; Dediapada (Rajpipla); Medha and Songadh (Navsari Dist.).

Measurements :	W	B	Tar.	T
9 ♂♂	64–71	12–14	17–18·5	47–52
1 ♀	66	12·5	17	49

Winter visitor. Fairly common. Earliest date October 3; latest April 7. Usually solo. Frequents mango topes near villages, large leafy banyan trees, and well-wooded residential compounds, etc.

Muscicapa tickelliae tickelliae (Blyth). Tickell's Redbreasted Blue Flycatcher.

Specimens collected : Gujarat: GS402 ♂ 28-11-45 Cambay ; GS657 ♂ 19-12-45, GS678 ♂ 21-12-45 Vaghjipur (Mehsana Dist.); GS1118 ♂ 27-3-46 Juna Rajpipla. Saurashtra: GS980 ♀ 12-3-46 Kodinar ; GS998 ♂, GS999 ♀ 15-3-46 Dalkhania (Amreli Dist.).

Elsewhere noted : Gujarat: Pavagadh (Panchmahals Dist.) ; Ajwa (Baroda Dist.); Balaram (Palanpur); Medha (Navsari Dist.); Waghai (Surat Dangs). Absent in Kutch.

Measurements :	W	B	Tar.	T
5 ♂♂	74–77	14·5–16	18·5–20	57·5–62
2 ♀♀	70·5–73	15–15·5	18·5	55·5–57

The females of this race are very similar superficially to males of the recent described *Cyornis poliogenys vernayi* Whistler of the Eastern Ghats. The latter, however, have longer tails (75·5–78·5) resulting in a different wing-tail index which is a good diagnostic clue. In female *tickelliae* the blue of the upper tail coverts is a trifle brighter, and the azure blue forehead and supercilium somewhat more pronounced. The underparts are pale ferruginous both in female *tickelliae* and in male *poliogenys vernayi*, but rather more albescent on the abdomen of the former.

Resident. Fairly common in secondary jungle. In the bamboo and mixed deciduous forest in the Surat Dangs (April) it was noted as one of the five commonest species, the others being *Dissemurus*, *Crypsirina*, *Alcippe* and *Hypothymis*. Till the first week of April, no sign of breeding activity was apparent.

Muscicapa thalassina thalassina Swainson. The Verditer Flycatcher.

Specimens collected: Gujarat: GS83 ♀ 1-11-1945 Ajwa (Baroda Dist.); GS404 ♂ 28-11-45, GS412 ♀, GS413 ♀ 29-11-45 Cambay; GS655 ♀, GS656 ♂ 19-12-45 Vaghjipur (Mehsana Dist.).

Not noted by the Surveys elsewhere in Gujarat, or in Saurashtra or Kutch.

Measurements :	W	B	Tar.	T
2 ♂♂	81–83	12·5–13·5	16	66–66·5
4 ♀♀	78–82	12–13	16	60–67

Winter visitor. Sporadic solos, or separated pairs, amongst groves of leafy trees near villages, and in wooded compounds, etc.

Culicicapa ceylonensis calochrysea Oberholser (= *pallidior* Ticehurst). The Greyheaded Flycatcher.

Specimens collected: Gujarat: GS414 ♂, GS415 ♂ 29-11-45, GS488 ♀ 6-12-45 Cambay; GS942 o ? 19-1-46 Hathidhara (Palanpur).

Elsewhere not noted in Gujarat, nor in Saurashtra or Kutch.

Measurements:	W	B	Tar.	T
3 ♂	63·5–67	12·5–13	13–14·5	52–60
1 ♀	62	12	13	53

According to Whistler (*Spolia Zeylanica*, 23 : 154) birds from the Eastern Himalayas and peninsular India, hitherto assigned as *ceylonensis*, are in fact intermediate between typical *ceylonensis* of Ceylon and *pallidior* Ticeh. of the NW. Himalayas. Specimens collected by the Central India Survey agree with East Himalayan material; so does a specimen obtained by me in the Hoshangabad Dist. of Madhya Pradesh (BNHS Coll.). Dr. Ripley considers that birds from the southern peninsula (south of about the latitude of Madras) go better with those from Ceylon.

Presumably winter visitor. Not common. Solos. Sits upright on upwardcurving dry twigs, usually fairly low down—8 to 12 ft. Very active. Swoops at insects and loops back to the same or other similar perch nearby.

Rhipidura aureola aureola (Lesson). The Whitebrowed Fantail Flycatcher.

Specimens collected : Gujarat: GS129 ♂, GS130 ♀ 5-11-45 Bodeli (Baroda Dist.); GS410 ♂, GS411 ♀ 29-11-45 Cambay; GS612 ♂ 17-12-45 Vaghjipur (Mehsana Dist.).

Elsewhere noted: Gujarat: Baroda City; Dabka and Padra (Baroda Dist.); Nadiad town and environs (Kaira Dist.); Patan (Mehsana Dist.); Dediapada (Rajpipla); Deesa, Balaram, Gangasagar, Hathidhara (Palanpur). Saurashtra: Ghatwad (Kodinar).

According to Lester 'it occurs in Kutch but is not common'. I failed to come across it there.

Measurements:	W	B	Tar.	T
3 ♂♂	79·5–90·5	14–16·5	18–20·5	84·5–97
2 ♀♀	76–80	15–15·5	18·5	86–90

This series, in coloration of upper parts, is darker sooty than 3 examples of *aureola* from Bahawalpur (W. Punjab) and Madhya Pradesh. 4 specimens of *compressirostris* from the Eastern Ghats are, by comparison, more *rusty* brown above.

The Bodeli birds (GS129, GS130) have two central pairs of rectrices all black (without white tips), a character given by Whistler for *compressirostris* (*JBNHS*, 36 : 92), and the tail of the male also falls within the range of that race, '82·5–87·5'.

The Cambay male (GS410) has only one central pair of rectrices all black; the female (GS411) two central pairs all black. In a male from Mehsana Dist. (GS612) the central pair is all black, the next also black but with a minute white dot at the extreme tip. The tails of the 2 males fall within the range given for *aureola* from the Punjab, namely 89–100 mm. Whistler in the Avifaunal Survey of Ceylon, 1944 (*Spol. Zeyl.*, 23 : 157) was apparently no longer so sure about the validity of the characters he gave, namely 1 central pair all black for *aureola*; 2 pairs for *compressirostris*.

I attribute the above specimens to *aureola* realizing that they are probably intermediate between birds from the Punjab and Ceylon, and taking note of the small size of the pair from Bodeli.

Resident. Rather patchily distributed; normally affecting drier and less wooded localities and facies than the Whitespotted Fantail. Frequently seen on open close-cropped grazing or fallow land with sparse scattered bushes of babul, etc., prancing, pirouetting with fanned erect tail, flycatching in looping-the-loop sallies near or actually on the ground, and riding momentarily on the backs of grazing goats and cattle. In such open country *pectoralis* is never seen, but in a few intermediate localities, e.g., Jaspur (Baroda Dist.), Vaghjipur (Mehsana Dist.), Hathidhara (Palanpur) the two were sometimes found side by side in patches of scrub jungle or old rambling residential compounds, and there even in the same tree! The habitat preferences of the two are distinct, but otherwise there is no difference in their habits. Wherever they occur together, therefore, they are competitors for food.

No data as regards breeding was obtained.

Rhipidura pectoralis pectoralis Jerdon. The Whitespotted Fantail Flycatcher.

Specimens collected: Gujarat GS84 ♂ 1-11-1945 Ajwa (Baroda Dist.); GS403 [♂] 28-11-45, GS409 ♂ 29-11-45, GS489 ♀ 6-12-45, Cambay; GS582 ♂, GS583 ♂ 15-12-45, GS613 ♀ 17-12-45 Vaghjipur (Mehsana Dist.); SD155 ♂ 5-3-48 Pandwa (Surat Dangs).

Elsewhere noted: Gujarat: Jaspur (Baroda Dist.); Hathidhara (Palanpur); Juna Rajpipla; Malegaon (Surat Dangs). Absent in Kutch.

Measurements:	W	B	Tar.	T
4 ♂♂	72–77·5	14–14·5	18·5–19·5	86·5–90
2 ♀♀	69–70	13–14	18·5–19	89
1 [♂]	78	15	20	95

R.p.vernayi of the Visakhapatnam ghats is a good and easily differentiated race.

Resident. Affects well-wooded, well-watered country, rambling jungly gardens with shrubbery, and groves of mango and similar low spreading trees. Never met with on open ground as *aureola* frequently is, but in borderline localities the two are sometimes found in the same patch and even in the same tree! The voice and song of the Gujarat birds was noted as appreciably different from that heard in the Bombay neighbourhood.

The male of March 5 was in freshly-moulted plumage with testes (only one!) enlarged to 8×5 mm. No other data as regards breeding were obtained by the Survey.

Hypothymis azurea styani (Hartlaub). The Blacknaped Blue Flycatcher.

Specimens collected: Gujarat: GS40 ♂ 30-10-45 Ajwa (Baroda Dist.); GS1119 ♂, GS1120 27-3-46 Juna Rajpipla; GS1211 ♀, GS1212 ♀ Medha (Navsari Dist.) SD10 ♀ 24-2-48, SD93 ♀ 29-2-48 Malegaon; SD134 ♂ 3-348 Galkund; SD211 ♂ 7-3-48 Pandwa; SD256 ♀ 11-3-48; SD288 ♂ 12-3-48 Laochali; SD385 ♂ 20-3-48 Sarwar; SD444 ♀ 24-3-48 Waghai; SD463 ♀, SD464 ♂ 25-3-48 Chikhli (Surat Dangs).

Saurashtra: B23 ♂ (1st year) 14-10-43 Dwarka (Okhamandal).

Elsewhere noted: Gujarat: Mheskatri, Pimpri (Surat Dangs). Absent in Kutch.

Measurements:	W	B	Tar.	T
8 ♂♂	69·5–74·5	15–17	16–18	67–72
8 ♀♀	67–72	15–16·5	16–17·5	65–71

B23, a first year male, is exactly similar to adult female.

Resident. One of the commonest birds in bamboo, teak and mixed deciduous forest. It hunts in trees and undergrowth as well as on the ground, flitting and prancing in the manner of the Whitebrowed Fantail Flycatcher, with tail spread and partly erected. None of the specimens showed any gonadal development between October 30 and April 7.

This flycatcher apparently has no song. Besides the harsh *sweech-wich* notes, no other calls were heard.

Terpsiphone paradisi paradisi (Linn.). The Paradise Flycatcher.

Specimens collected: Gujarat: GS1227 ♂ 9-4-1946 Medha (Navsari Dist.)

Measurements:	W	B	Tar.	T	Streamers
1 ♂ (chestnut)	98	24·5	17	119	damaged

Terpsiphone paradisi leucogaster (Swainson).

Specimens collected: Kutch: KS256 ♀ 21-9-43 Rapar. Gujarat: GS1107 ♂ 25-3-46 GS1117 ♀ 27-3-46 Juna Rajpipla; GS1135 ♂ 29-3-46 Dediapada (Rajpipla); SD8 ♂ 24-2-48 Malegaon; SD274 o? 12-3-48 Laochali; SD340 ♂ 16-3-48, SD359 ♀ 18-3-48 Mheskatri; SD434 ♂ 22-3-48 Pimpri (Surat Dangs).

Elsewhere noted (subspecies uncertain): Gujarat: Mahal (Surat Dangs). Saurashtra: Dalkhania (Amreli Dist.)

Measurements:	W	B	Tar.	T	Streamers
2 ♂♂ white	94–99	24–24·5	16·5–17	82 (1)	308–358
2 ♂♂ particolored chestnut and white	95–99	23–26·5	17–18·5	86–101	239–320
3 ♀♀	90–91	23–25	17·5–18	88·5–101	—

The subspecific identity of the white males as *leucogaster* rests mainly on the narrower bill possessed by this race.

The status of the Paradise Flycatcher in Gujarat needs to be determined. No doubt it varies from one locality to another within the area. I hazard a guess that *paradisi* is resident and breeds in the better wooded parts, e.g., Navsari District, Rajpipla and Surat Dangs, as it has recently been reported to do in the Gir Forest of Junagadh by K. S. Dharmakumarsinhji (*JBNHS* 48 : 188). *Leucogaster*, on the other hand, is purely a winter visitor and passage migrant as it is elsewhere in peninsular India. Most of the specimens of the latter were fat and suggestive of being in transit.

Fairly common in Gujarat during the winter months affecting shady, well-wooded forest nullahs, especially in the neighbourhood of pools.

In Kutch *leucogaster* is evidently an uncommon passage migrant, as it is in Sind, the only specimen recorded being on September 29.

Subfamily TIMALIINAE: Babblers

Pellorneum ruficeps ruficeps Swainson. The Spotted Babbler.

Specimens collected: Gujarat: GS1086 ♂ 24-3-46 Navagam (Rajpipla); GS1126 ♂ 27-3-46 Juna Rajpipla; GS1206 ♀, GS1207 ♀ 7-4-46 Medha (Navsari Dist.); GS1275 ♂ 16-4-46 Mahal (Surat Dangs).

Elsewhere noted: Gujarat: Ghantoli (Rajpipla); Galkund (Surat Dangs). Not met with by the Surveys in Saurashtra or Kutch.

Measurements:	W	B	Tar.	T
3 ♂♂	74·5–78	19–20·5	29–30	69–73
2 ♀♀	68–70	19–20	26–27·5	62·5–64

Occurs in Gujarat from the Narbada River southward (Rajpipla, Navsari District, Surat Dangs, etc.) in the appropriate biotope of hilly bamboo, teak and mixed deciduous secondary jungle. Frequent, but not common. Occasional song heard by mid-April, but no signs of breeding activity noted.

Pomatorhinus horsfieldi horsfieldi Sykes. The Deccan Scimitar Babbler.

Specimens collected: Gujarat: GS1215 ♂ 8-4-46, GS1237 ♂ 9-4-36 Medha (Navsari Dist.); GS1251 ♀, GS1252 ♂, GS1253♂, GS1254 ♀ 13-4-46 Waghai (Surat Dangs). SD49 ♀ 27-2-48 Malegaon; SD238 ♂ 10-3-48 Laochali; SD296 ♂ juv., SD297 ♀ juv., 14-3-48 Mahal; SD336 ♂ 16-3-48 Mheskatri; SD453 ♂ 24-3-48 Waghai (SD series = Surat Dangs).

Elsewhere noted: Gujarat: Dediapada and Ghantoli (Rajpipla). Not met with by the Surveys in Saurashtra or Kutch.

Measurements:	W	B	Tar.	T
6 ♂♂	93–100	33–35	31–35	95–100
3 ♀♀	89·5–93	33–34·5	31–33	92–98

The young birds collected on March 14 are in the characteristic fluffy plumage of juvenile timalines, and rufous-brown on the back instead of olive-brown. Forehead, sides of head and neck, and side of breast bordering the white plastron, rusty rufous, continuing behind as a diffuse nuchal collar. In other words the rusty rufous cheeks extend down on either side enclosing the white chin, throat and upper breast. Bill: lower mandible and tip of upper mandible pinkish flesh; base of upper mandible horny; gape pinkish flesh. Legs and feet plumbeous. This pattern in a more accentuated form is seen in adult *Pomatorhinus schisticeps* and suggests that the two species may be more closely related than has hitherto been recognised.

This series as a whole is inseparable from *horsfieldi* from Bombay and the Eastern Ghats. *P. h. obscurus* (type locality Mt. Abu) is an easily distinguishable race, conspicuously greyer above and below with no black band separating the white of the breast from the upper plumage. Birds from north of the Tapti River show intergrading; they are a shade greyer above and surrounding the white breast, which in good light the 'eye of faith' can just perceive. If therefore some boundary must needs be fixed between the ranges of *P. h. horsfieldi* (more olive above) and *P. h. obscurus* (more grey above) I propose to make it the Tapti River. All birds north of the Tapti to be arbitrarily considered *obscurus* and all birds south of it *horsfieldi*.

The exact eastern limit of *obscurus* needs to be determined. It is said to occur in the neighbourhood of Seoni in the Satpuras, *ca.* 350 miles ENE. of Medha. In *JBNHS*, 31 : 1032 I had recorded its extension to Orissa, but on re-examining the specimen upon which this was based (Reg. No. 2272 BNHS Coll.) I am not convinced of its identity as *obscurus*. It may just be a faded example of *horsfieldi* of which Koelz obtained specimens at Mahendragiri (*JBNHS*, 47 : 129) and to which my own birds collected in Bastar and Orissa hills belong.

Fairly common in broken foothills country in southern Gujarat in appropriate biotope—bamboo and mixed deciduous forest. Pairs or parties of 7 to 10. When feeding high up amongst bamboo culms or tree-tops, it hops along swiftly from branch to branch to escape, when alarmed, and dives obliquely into the undergrowth. Calls in 'duets': *Oop-upupupupu . . . krokānt* (male . . ., female).

Dumetia hyperythra albogularis (Blyth). The Small Whitethroated Babbler.

Specimens collected: Gujarat; GS273 ♂, 17-11-1945, GS296 ♀, GS297 o?, GS298 ♂ 19-11-45 Dabka (Baroda District.); GS393 ♂, GS394 ♀, GS395 ♂ 28-11-45 Cambay; GS627 ♂ 18-12-45, GS675 ♂, GS676 ♀ Vaghjipur (Mehsana Dist.); GS1136 ♂ 29-3-46 Dediapada (Rajpipla).

Elsewhere noted: Gujarat: Baroda City and environs; Pavagadh and Champaner (Panchmahals Dist.); Balaram and Hathidhara (Palanpur); Juna Rajpipla; Waghai (Surat Dangs). Saurashtra: Ghatwad and Kodinar (Amreli Dist.); Bhavnagar (specimen: K. S. Dharmakumarsinhji).

Absent in Kutch.

Measurements:	W	B	Tar.	T
6 ♂♂	56–58	(13) 13·5–15	18–20	64–67
5 ♀♀	53–55·5	(13) 13·5–15	19–21·5	58–66

Post-nuptial moult completed by about mid-November.

Ceylon birds recently separated as *phillipsi* Whistler (*Spol. Zeyl.* 23 : 134) and also birds from Travancore, are said to have larger and sensibly heavier bills. I have seen no specimens from Ceylon, but two Travancore Survey skins in the BNHS Coll., re-examined and measured, show no appreciable difference from the Gujarat series in this regard.

Common in scrub jungle, particularly where cut up by ravines. No evidence as to breeding was supplied by the specimens.

Chrysomma sinense hypoleuca (Franklin). The Western Yelloweyed Babbler.

Specimens collected: Kutch: KS92 ♂ 19-8-1943, KS99 ♂ 21-8-43 Chaduva (Bhuj Dist.). Gujarat: GS57 ♂ 31-10-45 Ajwa (Baroda Dist.); GS299 ♂, GS300 ♀ 19-11-45, GS326 o? 20-11-45 Dabka (Baroda Dist.); GS598 o? 16-12-45 Vaghjipur (Mehsana Dist.); GS743 ♂ 27-12-45 Patan (Mehsana Dist.); GS843 o? 9-1-46 Deesa (Palanpur); GS1185 ♂ GS1186 ♀ 2-4-46 Dediapada (Rajpipla).

Elsewhere noted: Kutch: Rudra Mata (Bhuj Dist.). Gujarat: Cambay; Golana (Cambay); Nadiad, Mehmedabad (Kaira Dist.); Radhanpur; Hathidhara (Palanpur); Juna Rajpipla; Kharaghoda.

Not recorded by the Survey from Saurashtra.

Measurements:	W	B	Tar.	T
6 ♂♂	61·5–70	14·5–15	22–27	80–98
2 ♀♀	63–64	14–16	25–27	88–90

Complete post-nuptial moult in progress, or just completed, October–November.

Kutch birds are certainly *hypoleuca*, but I attribute the Gujarat specimens to this race more for convenience than from conviction. *Hypoleucus* is paler and more grey on the upper parts than *sinense*. While some freshly-moulted examples from among the Gujarat series can be matched with similarly fresh plumaged specimens of *hypoleuca* from Jodhpur and Bahawalpur, others can be matched just as satisfactorily with examples of *sinense* collected by the Eastern Ghats Survey (e.g., at Kurumbapatti in Salem Dist.) or by myself in Gwalior. At best it seems to me that Gujarat birds can only be considered intermediate. Their paleness and greyness is by no means always obvious, and in some cases even extremely doubtful. I cannot see that birds from N. Gujarat (Mehsana Dist., Palanpur) are markedly paler than those from S. Gujarat (Rajpipla).

Not uncommon, but rather local. Affects scrub-covered eroded ravines, reeds and brushwood by streams, and patches of tall coarse grass and thorn thickets separating fallow fields. In these facies commonly seen in association with the wren-warblers *Prinia socialis* and *inornata*, and *Franklinia buchanani*.

In full song and breeding in August (Kutch); full-fledged young on wing in September. Butler (*SF*, iii : 471—1875) saw several nests near Deesa in July and August.

Turdoides somervillei somervillei Sykes. The Bombay Babbler.

Specimens collected : Gujarat: GS1275 ♀ 13-4-46 Waghai, GS1299 ♂ 17-4-46 Mahal (Surat Dangs); SD28 ♀, SD29 ♂ 25-2-48 Malegaon; SD236 ♂, SD237 ♂ 10-3-48 Laochali; SD310 ♂, SD311 ♂, SD312 ♂ 14-3-48 Mahal; SD446 ♀ 24-3-48 Waghai (SD series = Surat Dangs).

Measurements :	W	B	Tar.	T
8 ♂♂	98(1) 102–109 (mostly 108–109)	22·5–26	34(1)35·5–37·5	98–109
3 ♀♀	109	23·5–25	36–38	106–111

These specimens show that the northern limit of the rufous-tailed typical race *somervillei* extends at least up to the Tapti River. Unfortunately no specimens were collected in the Rajpipla area immediately north of this river, between it and the Narbada.

Turdoides somervillei orientalis ≷ sindianus. The Jungle Babbler.

Specimens collected : Gujarat: GS223 ♂ 11-11-45 Bodeli (Baroda Dist.); GS362 ♂, GS363 ♀ 22-11-45 Dabka (Baroda Dist.); GS400 ♀ 28-11-45 Cambay; GS532 ♂, GS533, GS534 ♀ Nadiad environs (Kaira Dist.); GS659 ♂ 19-12-45 Vaghjipur (Mehsana Dist.); GS933 ♀ 18-1-46 Gangasagar (Palanpur); GS1072 ♀, GS1073 ♂ 21-3-46 Kharaghoda. Saurashtra: GS965 ♂, GS966 ♀ 11-3-46 Ghatwad (Amreli Dist.).

Elsewhere noted: Gujarat: Baroda City and environs; Ajwa; Pavagadh; Jambughoda; Radhanpur; Palanpur; Juna Rajpipla; Dediapada (Rajpipla). Saurashtra: Veraval town (Junagadh); Kodinar (Amreli Dist.)

Measurements :	W	B	Tar.	T
6 ♂♂	94 (1)—109 (mostly 106 +)	21·5–24	34·5–38	100–117
7 ♀♀	100–111	22·5–24·5	34·5–36	103–112

Birds from north of the Narbada River, and northern Gujarat and Saurashtra, are intermediate between *orientalis* and *sindianus*, the case being more or less parallel with that of *Crypsirina v. vagabunda* and *C. v. pallida*. The two specimens from Kharaghoda (GS1072 & GS1073), however, are paler and greyer above and distinctly closer to *sindianus*.

Fairly common in well-wooded tracts—in public gardens, private compounds, groves of trees near villages, overgrown ravines covered with dhâk (*Butea*) and other scrub, as well as in light deciduous jungle. On the borderline of their respective preferential habitats, associating freely with both the Common Babbler (*Turdoides caudata*) and the Large Grey Babbler (*T. malcolmi*). The absence or scarcity of Jungle Babblers in any patch of jungle, I found to be a reliable indicator of the paucity of bird life therein. Everywhere these birds seem to form the nucleus of the avian foraging parties.

The breeding season is as irregular and ill-defined as elsewhere. While the gonads of the majority of specimens were quiescent, somewhere in differential stages of development and two of the three Nadiad birds (December 10) were certainly breeding.

During several months' field work in Kutch, when the country was combed fairly thoroughly, I failed to come across the Jungle Babbler though in such localities as Mata-no-Madh, and some others, all the requisite ecological conditions seemed present. Neither Hugh Palin, who originally published a list of Kutch birds in 1878, nor Capt. Lester, who revised and added to it in 1903, make mention of the species. It appears, however, that Hume had actually seen specimens collected in Kutch (*SF*, iii: 472—1875), and it is also included in Stoliczka's list of Kutch birds published in 1872 (*JASB*, vol. 51). What has happened to the species since is a point that perhaps merits investigation.

Turdoides caudata caudata (Dumont.) The Common Babbler.

Specimens collected: Kutch: KS10 ♀ 8-8-43 Rudra Mata (Bhuj Dist.); KS403 ♂ 24-3-44 Chobari (Bhachau Dist.); Gujarat: GS264 ♀, GS265 ♂ 17-11-45, GS307 ♀, GS308 ♀ 19-11-45 Dabka (Baroda Dist.); GS471 ♂ Golana (Cambay); GS547 o? juv. 11-12-45 Nadiad (Kaira Dist.); GS1077 ♂ 21-3-46 Kharaghoda.

Elsewhere noted: Kutch: Kandla; Padhar; Mandvi; Anjar; Bhachau; Kala Dongar (Pachham); Pung Bet (Little Rann) etc. Saurashtra: Dwarka; Okha; Amreli; Dhari; Kodinar. Gujarat: Baroda City and environs; Vaghjipur (Mehsana Dist.); Deesa; Palanpur environs; Radhanpur.

Measurements:	W	B	Tar.	T
4 ♂♂	76–81	21–22·5 (25)	26·5–28·5	114–117
5 ♀♀	(73) 77–82	20–22	27–29·5	moult

No. GS264 was undergoing complete moult whilst laying. Oviduct distended; largest ovum 3 mm. diameter!

Common over a wide range of terrain from right away on the barren Rann through sandy cultivation with scrub interspersed, to fairly thick but dry thorn and scrub jungle. Associating with both the Large Grey and the Jungle Babbler along the seams of the preferential habitats of either. Dry sandy ravines bordered with scrub of *Capparis*, *Zizyphus*, *Acacia* and *Prosopis* are its favourite haunts. In season, feeds largely on the nectar of *Capparis aphylla* flowers. The birds get their foreheads thickly coated with the yellow pollen and are doubtless responsible for a considerable amount of cross-fertilization.

There seems to be no definite breeding season, and odd birds may be found nesting throughout the year. Practically all the Survey specimens showed gonadal development, or gave some indication of current or recent breeding activity. The moults are also irregular, and practically every stage of moult may be seen in different individuals at any time of the year.

On two occasions pairs were observed feeding and fussing over nearly grown fledgling Pied Crested Cuckoos (*Clamator jacobinus*), a singleton in one case and 'twins' in the other.

Turdoides malcolmi (Sykes). The Large Grey Babbler.

Specimens collected : Gujarat; GS309 ♂ 19-11-45, GS341 ♂, GS342 ♀ 21-11-45 Dabka (Baroda Dist.); GS384 ♀, GS385 ♀ 27-11-45 Cambay.

Elsewhere noted: Gujarat: Baroda City and environs; Nadiad (Kaira Dist.); Vaghjipur (Mehsana Dist.); Radhanpur; Deesa ; Palanpur town and environs; Kharaghoda; Juna Rajpipla. Saurashtra: Dwarka; Okha; Amreli; Dhari; Kodinar; Veraval (Junagadh).

Measurements :	W	B	Tar.	T
2 ♂♂	120	24·5–27	36	135–136
3 ♀♀	114–117	23–24	34–35	133–136

Certainly the commonest babbler in the open cultivated plains country of Gujarat and Saurashtra. Frequently seen in association with both or either the Common and Jungle Babblers in appropriate facies.

In Kutch it was not met with at all, neither does Lester include it in his list (1903). Hume (*SF,* iii: 472—1875) speaks of it, however, as being 'not uncommon in the less desert portions of Kutch'. It has also been recorded from Kutch by Stoliczka (*JASB,* 51—1872).

The specimens of November 19 and 20 were freshly moulted with partially developed gonads. No further data as regards actual breeding in the area were procured.

Alcippe poioicephala brucei Hume. The Bombay Quaker Babbler.

Specimens collected: Gujarat: GS1202 ♂, GS1203 ♂, GS1204 ♀, GS1205 ♀ 7-4-46, Medha (Navsari Dist.); GS1262 ♂ 13-4-46 Waghai; SD16 ♂ 24-2-48, SD57 ♂ 27-2-48 Malegaon; SD273 ♂ 12-3-48 Laochali; SD313 ♀ 14-3-48 Mahal; SD346 ♂ 17-3-48 Mheskatri; SD378 ♂ 19-3-48 Sarwar; SD410 ♀ 21-3-48, SD425 ♂ 22-3-48 Pimpri; SD449 ♂, SD450 ♀, SD451 ♀, SD452 ♀ 24-3-48 Waghai (SD = Surat Dangs).

Not met with by the Surveys elsewhere in Gujarat or in Kutch or Saurashtra, but Harrington (*JBNHS,* 23: 451) recorded it from Rajkot, somewhat north-west of the Surat Dangs and in approximately the latitude of Baroda City.

Measurements:	W	B	Tar.	T
10 ♂♂	66–73	15–17·5	22–24·5	62–66·5
7 ♀♀	66·5–73	15–16·5	21–23·5	59–65

One of the 5 commonest birds in hilly teak, bamboo and mixed deciduous jungle in the Surat Dangs and the Songadh area, the other species being *Dicrurus paradiseus*, *Crypsirina vagabunda*, *Hypothymis azurea* and *Muscicapa tickelliae*. Very fond of flower nectar, and in season invariably present on the blossoms of *Firmiana colorata* and *Erythrina stricta*, among others. No indication as regards breeding was provided by the specimens.

Subfamily SYLVIINAE : Warblers

Hippolais caligata caligata Licht. (=*scita* Eversm.) The Booted Tree-Warbler.

Specimen collected: Gujarat: SD461 ♂ 25-3-48 Chikhli (Surat Dangs.)

Measurements :	W	B	Tar.	T
1 ♂	62	14·5	20·5	51

Hippolais caligata rama (Sykes). Sykes's Tree Warbler.

Specimens collected: Kutch: KS11 ♂, KS12 o ? 8-8-43 Rudra Mata; KS67 ♂ 16-8-43 Chaduva, KS153 o ? juv. 3-9-43 Nakhatrana; KS174 ♀ juv. KS175 ♂ juv. 6-9-45 Manjal; KS187 ♂, KS188 o? KS189 ♂ 8-9-43 Rudra Mata; KS233 ♂ 16-9-43 Anjar, KS240 ♂, KS244 o? juv. 17-9-43 Bhachau; KS274 ♀ 26-9-43 Rudra Mata; KS286 ♀ 28-9-43 Bhuja Fort; KS373 ♂ 15-3-44 Jakhau; KS386 ♀ 18-3-44 Lakhpat; KS411 ♂ 25-3-44 Dholovira (Khadir Island); KS420 ♀ 28-3-44 Bela Island. Gujarat: GS36 ♂ 29-10-45, GS116 ♀ 3-11-45 Ajwa (Baroda Dist.) GS202 o? 9-11-45 Bodeli (Baroda Dist.); GS621 ♀ 17-12-45, GS677 ♂ 21-12-45 Vaghjipur (Mehsana Dist.); GS699 ♂ 24-12-45, GS753 ♂ 28-12-45 Patan (Mehsana Dist.); GS924 ♂16-1-46 Palanpur; SD365 ♂ 18-3-48 Mehskatri (Surat Dangs). Saurashtra: B29 ♂ 17-10-43 Amreli; GS976 ♀ 11-3-46 Ghatwad (Kodinar);

Elsewhere noted: Kutch: Kandla; Khavda, Nir (Pachham Island); Mandvi; Pung Bet (Little Rann) Saurashtra: Dalkhania. Gujarat: Champaner (Panchmahals); Dabka (Baroda); Cambay; Palanpur; Rajpipla.

Measurements :	W	B	Tar.	T
10 ♂♂	60–64	15–16·5	20·5–22	50–56
7 ♀♀	59–62	15–16	20–21·5	49–54

August specimens are mostly in worn bedraggled plumage; general moult takes place about September. In fresh winter plumage *Hippolais c. rama* can be differentiated from *H. c. caligata* in the hand (but not always in the field) by its uniform mousy grey-brown upper parts with slight olive tinge, against darker more fulvous brown in the latter. *Rama* is more a bird of semidesert country whereas *caligata* prefers less arid parts. In the Surat Dangs both forms occurred in the same locality in winter (March).

H. c. rama possibly resident in small numbers, but increasing from August on, and abundant between September and January. Affects babul, kandi and similar scrub jungle, keeping to the foliage canopy. Also seen in tamarisk bushes along river beds, e.g., in Kutch. In habits and movements it closely resembles the willow-warblers (*Phylloscopus*). Usually seen singly, restlessly hunting insects amongst the leaves and twigs, uttering a harsh *chuck . . . chuck* or *chur-r*, *chur-r* from time to time which may be mistaken for the notes of the Lesser Whitethroat.

Sylvia communis icterops Menetries. The Indian Whitethroat.

Specimens collected: **Kutch**: KS135 o? KS136 ♂, KS137 ♂ 31-8-43 Bhuj environs; KS141 ♀, KS142 ♀ 1-9-43 Bhuj; KS155 ♂ 3-9-43, KS162 ♂ 5-9-43, KS173 ♂ 6-9-43 Nakhatrana; KS190 ♀, KS191 ♂ 8-9-43 Rudra Mata. **Saurashtra**: B18 ♂ 14-10-43 Dwarka; B35 ♂ 18-10-43 Amreli.

Elsewhere noted: **Kutch**: Kandla; Anjar; Bhachau; Rapar; Chaduva; Nir (Pachham Island.)

Measurements :	W	B	Tar.	T
8 ♂♂	73–77	11–13	20–22	60–65
3 ♀♀	73–76	13	21·5–22	58–66

An abundant passage migrant over Kutch and Saurashtra in autumn to its winter quarters in Egypt and NE. Africa. First observed August 31; literally swarming between September 8 and 18; progressively less thereafter, and all gone by October 10 when the last individual was recorded. On return passage from Africa the birds apparently travel by a different route. Not a single specimen was observed in Kutch between March 3 and April 3. The bulk of the autumn passage seems to avoid the mainland. None were observed in Gujarat or east of a line from Rapar in Kutch to Amreli in Saurashtra. Acccording to F.B.I. (ii : 447) it wanders as far south as Mt. Abu and Deesa and as far east at Kanpur.

Partial to sand mounds with tufts of *Capparis* and other scrub, scattered like islets amidst cultivation. The birds were completely silent during their temporary sojourn. Most of the specimens were fat; some excessively so.

Sylvia hortensis jerdoni (Blyth). The Eastern Orphean Warbler.

Specimens collected: **Kutch**: KS169 ♂ 6-9-43 Manjal; KS180 ♂ 7-9-43 Bhujia Fort; KS235 ♂, KS236 ♂ 17-9-43 Bhachau; KS419 ♀ 28-3-44 Bela Island (Great Rann). **Gujarat**: GS87 ♀ 1-11-45 Ajwa (Baroda Dist.); GS172 o ?, GS173 ♀ 9-11-45 Bodeli; GS256 ♂ 17-11-45 Dabka (Baroda Dist.); GS423 ♀ 29-11-45 Cambay; GS484 ♂ 4-12-45 Golana (Cambay); GS604 ♀ 16-12-45 Vaghjipur (Mehsana Dist.); GS793 ♂ 1-1-46 Radhanpur; GS1079 ♂ 21-3-46 Kharaghoda.

Elsewhere noted: **Kutch**: Dholovira (Khadir Island): Rapar (Waghad Dist.); Pung Bet (Little Rann); Khavda (Pachham Island); **Saurashtra**: Amreli; Dhari. **Gujarat**: Rajpipla.

Measurements :	W	B	Tar.	T
7 ♂♂	79–86	19·5–21	(21) 23–25	66–72
5 ♀♀	80–83	19–21·5	23·5-25	67–71

Common winter visitor. Solos frequent. First seen September 1; last March 31. Affects semidesert country keeping to *Capparis* bushes among the sand dunes or outscoured ravines, and to *Prosopis* and babul scrub. Feeds regularly on nectar of *Capparis* flowers, and usually has a quantity of the yellow pollen adhering to feathers of forehead. Utters *chichirichich* while hopping amongst bushes. Specimens collected in March were very fat in preparation for emigration.

Sylvia nana nana (Hempr. & Ehr.). The Desert Warbler.

Specimens collected: **Kutch**: KS366 ♀ 12-3-44 Mandvi.

Measurements :	W	B	Tar.	T
1 ♀	57	11·5	18·5	47

Colours of soft parts: Iris bright lemon yellow; bill & legs pale chrome yellow; upper mandible brownish.

Not common. Very like a miniature *Agrobates* in the field. Keeps to 'khip' bushes (*Leptadenia spartium* and ground among the barer wind-rippled coastal sand-dunes. Fragments of a pleasant reeling song were occasionally uttered from the ground, under the shelter of a bush. When singing, often spreads and partly erects tail like *Rhipidura*, displaying the white-tipped fan which further accentuates its likeness to *Agrobates*.

Sylvia curruca blythii Ticeh. & Whistler: The Indian Lesser Whitethroat.

Specimens collected: Kutch: KS226 o?, KS227 ♂ 15-9-43 Anjar; KS246 ♀ 20-9-43, KS260 ♀ 22-9-43 Rapar; KS270 ♀ Bhujia Fort; KS280 ♂, KS281 ♂ 27-9-43 Bhuj Environs; KS307 ♀ 2-10-43 Khavda; KS322 ♂ 5-10-43 Nir; KS333 ♀ 5-3-44 Bhuj; KS364 ♀ 12-3-44 Mandvi; 393 ♀ 21-3-44 Godsar; KS405 ♂ 24-3-44 Chobari; Saurashtra: B30 o? 17-10-43 Amreli; Gujarat: GS35 o? 29-10-45, GS117 ♂, GS118 ♂ 3-11-45; GS242 ♂ 15-11-45 Baroda city environs; GS201 o? 9-11-45 Bodeli; GS269 ♀ 17-11-45 Dabka (Baroda Dist.); GS479 ♀ 4-12-45 Golana (Cambay); GS603 ♀ 16-12-45 GS620 ♀ 17-12-45; Vaghjipur (Mehsana Dist.); GS794 ♀ 1-1-46 Radhanpur; GS1040 o? 19-3-46, GS1069 ♂ 21-3-46 Kharaghoda; SD268 ♂ 12-3-48 Laochali (Surat Dangs).

Measurements:	W	B	Tar.	T
7 ♂♂	61–68	12–13·5(15)	18–23	55–60
8 ♀♀	61–65	11·5–13·5	18·5–21	53–58

Common, abundant and widely spread winter visitor to this area. Earliest date 15 September; latest 2 April, but doubtless leaves later.

Affects groves of babul and *Prosopis* (kandi), and thorn thickets and scrub, with a preference for semidesert country. Hops about the foliage hunting insects and uttering from time to time a subdued *tek, tek* like the low clicking of ones tongue against the palate. This is distinct from the harsh *chuck* or *chur-r* of Sykes's and several other tree warblers. Feeds regularly on the nectar of Babul and *Capparis aphylla* flowers, and specimens usually have their forehead feathers thickly coated with the pollen of these. It was noticed that the birds—this as well as other species—for some reason avoided the luxuriant growth of *Prosopis juliflora*, an introduced species that has colonised dry tracts in the Radhanpur and Palanpur areas with phenomenal success, though *Prosopis spicigera*, the indigenous species, is greatly favoured everywhere!

In my 'Birds of Kutch' (p. 34) I have recorded a specimen of the Small Whitethroat, *S. c. minula*. On a re-examination of the skin I find that this was a mistake. In all the specimens taken in Gujarat, Saurashtra and Kutch there are no *minula* at all although it *may* occur in small numbers in winter.

Sylvia althoea Hume. Hume's Lesser Whitethroat.

Specimen collected: SD133 ♂ 3-3-48 Galkund (Surat Dangs)

Measurements:	W	B	Tar.	T
1 ♂	67	15	20	59

Possibly often confused with *S. c. blythii* in the field.

Phylloscopus collybita tristis Blyth. The Brown Willow-Warbler.

Specimens collected: Kutch: KS351 ♀ 9-3-1944 Mandvi; Gujarat: GS63 o? 31-10-45, GS119 ♂, GS120 ♂ 3-11-45 Ajwa (Baroda Dist.); GS162 ♀ 7-11-45, GS199 ♂, 9-11-45 Bodeli (Baroda Dist.); GS429 ♂ 28-11-45 Cambay; GS602 ♀ 16-12-45 Vaghjipur (Mehsana Dist.); GS782 ♀ 31-12-45 Radhanpur; GS1057 ♂ 20-3-46 Kharaghoda.

Measurements:	W	B	Tar.	T
5 ♂♂	61–65	11–13	19–21	47–51·5
4 ♀♀	57–59	10·5–11·5	19–19·5	45–49

Common winter visitor. Latest date recorded by the Survey, March 20. The specimen of that date was very fat suggesting preparedness for emigration. Abundant in low babul scrub and bushes of *Phyllanthus reticulatus* on drying up moist margins of tanks, ponds, etc. Flits about restlessly with the characteristic phylloscopine nervous flicks of the wings. Also affects reeds standing in water. Here it feeds off the stems as well as from the water's surface, reaching down or lunging out for a floating insect, and quickly transferring itself to an adjacent stem when the perch bends over into the water with its weight. Sometimes flutters momentarily in front of Cypress grass flower-clusters to capture an insect. Except for an occasional plaintive tweet, the birds were silent.

Phylloscopus griseolus Blyth. The Olivaceous Tree-Warbler.

Specimens collected: Gujarat: GS329 o? 20-11-1945 Dabka (Baroda Dist.); GS535 o? 10-12-45 Nadiad (Kaira Dist.); SD77 ♂ 28-2-48 Malegaon; SD99 ♂ 1-3-48 Galkund (Surat Dangs).

Elsewhere noted: Gujarat: Jambughoda (Panchmahals Dist.).

Not observed in Kutch or Saurashtra.

Measurements:	W	B	Tar.	T
2 ♂♂	65–67	14	20	49–51
2 o?	65–68	14·5–15	21	50–53

Keeps singly to tree trunks and rock outcrops scuttling up like a nuthatch or tree creeper in search of tiny insects. Constantly flicks its wings and utters a monosyllabic finch-like *pick* from time to time. One of the easiest Phylloscopi to identify in the field: No wing bars; upper parts and wings greyish brown; breast and underparts yellow; yellow supercilium and brown streak through eye.

Phylloscopus inornatus humei (Brooks). Hume's Willow-Warbler.

Specimens collected: Gujarat: GS200 o? 9-11-45 Bodeli (Baroda Dist.); GS348 ♂ 21-11-45 Dabka (Baroda Dist.); GS430 ♂ 29-11-45 Cambay town environs; GS492 o? 6-12-45; SD52 o?, SD53 ♀ 27-2-48, SD80 ♂ 28-2-48 Malegaon; SD199 ♀ 6-3-48 Pandwa; SD336 ♂ 16-3-48, SD354 o? 17-3-48 Mheskatri (Surat Dangs).

Measurements:	W	B	Tar.	T
4 ♂♂	51–59	10·5–12·5	18–19	38·5–45
2 ♀♀	52–57	11–11·5	18	38–43
4 o?	54–60·5	11-13	18–19	38–46

No sight records of the Gujarat or Saurashtra Surveys are given owing to the uncertainty of correct identification. This species was, however, common in the Surat Dangs in February 1948 as confirmed by my companion, Mr. Horace Alexander, who has made a special study of Phylloscopi in the field. The following points help to identify this willow-warbler: Two wing bars of which the hind one is distinct and the the front one faint. Comparatively short tail. Long whitish supercilium. Call note *tis-yip* or *chilip*. Seen up in trees as well as bushes.

Phylloscopus trochiloides nitidis Blyth. The Green Willow-Warbler.

Specimens collected: Kutch: KS311 o?, KS312 o? 3-10-43 KS314 ♂ 4-10-43 Khavda (Pachham Island); KS273 ♂ 26-9-43 Bhuj; Gujarat: GS163 ♂ 8-11-45 Bodeli (Baroda Dist.); GS1258 ♂ 13-4-46 Waghai (Surat Dangs).

Measurements :	W	B	Tar.	T
4 ♂♂	58·5–65	12–14	18–20	45–49
2 o?	62–64	13–13·5	18·5–19·5	46

Phylloscopus trochiloides viridanus Blyth. The Greenish Willow-Warbler.

Specimens collected: Gujarat: GS428 o? 29-11-45 Cambay; SD78 ♂ 28-2-48 Malegaon; SD399 ♂ 20-3-48 Sarwar; SD430 ♂ 22-3-48 Pimpri; SD369 ♂ 18-3-48 Mheskatri (SD = Surat Dangs).

Sight records not given owing to uncertainty in field identification.

Measurements :	W	B	Tar.	T
4 ♂♂	59–64	12–13	18–19	44–48
1 o?	58	11	19	45

The two races are impossible to differentiate in the field, and even in the hand they present some difficulty. Both of them, moreover, have an identical call note in winter—a squeaky *chiwee*. The earliest and latest dates, supported by specimens, are September 26 and April 13. The latter specimen was excessively fat in readiness for emigration.

Perhaps the commonest species of willow-warbler in the area. Feeds mostly up in the foliage canopy of trees in openly wooded country.

Phylloscopus trochilus acredula (Linn.). The Northern Willow-Warbler.

Specimen collected: Gujarat; GS1137 ♂ 29-3-1946 Dediapada (Rajpipla).

Measurements :	W	B	Tar.	T
1 ♂	63	13·5	19	46

This is an unexpected addition to the Indian list. It was kindly identified for me by Col. R. Meinertzhagen, who had his diagnosis confirmed by Dr. James Harrison. It is a north European bird which normally winters in south and east Africa.

Phylloscopus occipitalis occipitalis (Blyth). The Large Crowned Willow-Warbler.

Specimens collected: Gujarat: GS149 o? 6-11-45 Bodeli (Baroda Dist.); SD227 ♂, SD228 ♀ 9-3-48 Laochali; SD252 ♂, SD253 ♂ 11-3-48, SD335 ♂ 16-3-48, SD353 ♂ 17-3-48 Mheskatri; SD441 ♀, SD442 ♀ 24-3-48 Waghai (SD = Surat Dangs).

Measurements:	W	B	Tar.	T
5 ♂♂	64–70	14–15	18–19	49–52
3 ♀♀	63–70	13·5–14	18–19	47–55·5

This is another species comparatively easy to identify in the field. Faint single wing-bar; body slim and long as in the Greenish Willow-Warbler with proportionate tail, not short as in *P. i. humei*; a coronal band; conspicuously orange bill; yellow wing shoulders and axillaries.

Most of the specimens were undergoing body moult, while some were freshly moulted. They were obviously preparing to emigrate in March. All collected in that month were fat to excessively fat and, contrary to their normal winter habit, the birds were then moving about in small flocks. The birds were silent until 24 March when the first song was heard—a squeaky but lively *chi-chi-chi*, *chwei*, *chwei*, *chwei*, *chwei*, quickly repeated.

Keeps to the foliage canopy of moderate sized trees, often associated with the itinerant hunting parties of mixed species.

Phylloscopus tytleri Brooks. Tytler's Willow-Warbler.

Specimens collected: Gujarat: SD50 ♂, SD51 ♀ 27-2-1948, SD79 o? [♀] 28-2-48 Malegaon (Surat Dangs).

Measurements:	W	B	Tar.	T
1 ♂	63	13	19	44
1 ♀	56	13	18·5	38·5
1 o? [♀]	57	13·5	18·5	40

Field identification: No wing bar; conspicuously long slender bill reminiscent of the tailor bird's (*Orthotomus*); upper parts olive; underparts whitish with indefinite yellowish streaks; long whitish supercilium.

The species was not uncommon where the specimens were collected.

Chaetornis striatus (Jerdon). The Bristled Grass Warbler.

Not met with by the Surveys. According to Capt. A. E. Butler (*S.F.*, v : 209) not uncommon about Deesa (North Gujarat) in the rains at which season it breeds. He invariably found the birds during the rains in grass *bheerhs* overgrown with low thorny bushes of *Zizyphus jujuba*, etc., but was not certain if it was a resident species. He emphasizes its close superficial resemblance to the Common Babler (*Turdoides caudata*) and thinks that it may therefore escape notice at other seasons.

Locustella naevia straminea. Seebohm. The Eastern Grasshopper Warbler.

Specimens collected: GS468 ♂ 3-12-1945, GS478 ♂ 4-12-45 Golana (Cambay).

Elsewhere noted: Gujarat: Ajwa (Baroda Dist.); Timbi tank and Harni (Baroda City environs).

Measurements:	W	B	Tar.	T
1♂	61	14	19·5	53

Winter visitor. In the above localities it was not common or abundant, but one or two solos were usually to be flushed in likely patches—

tall standing or flattened down grass at the edge of drying-up tanks or in swampy depressions. On one occasion several individuals had gathered to mob a snake in a thicket. Their agitated *cht-cht-cht* sounded rather like that of *Dumetia hyperythra*.

Acrocephalus stentoreus brunnescens (Jerdon). The Indian Great Reed Warbler.

Specimens collected: Kutch: KS234 ♂ 17-9-1943 Bhachau Gujarat: GS10 ♂ 28-10-45, GS25 o? 29-10-45, GS113 o? 3-11-45 Ajwa (Baroda Dist.); GS239 ♂ 15-11-45 Baroda City environs; GS1037 ♀, GS1038 ♂ 19-3-46, GS1056 ♂ 20-3-46 Kharaghoda.

Elsewhere noted; Gujarat: Cambay town environs; Kanewal (Cambay); Kutch: Nir (Pachham Island).

Measurements:	W	B	Tar.	T
2 ♂♂	84–89	25–26	28–28·5	73–80
1 ♀	85	22·5	27·5	72

Birds collected in September and October were in very worn plumage or undergoing heavy moult. Thereafter they were mostly freshly moulted, and the specimen of March 20 was fat.

Fairly common in reed beds and shrubbery around the edges of tanks. Once seen amongst *Salvadora* thickets bordering a bajri (*Sorghum*) field a considerable distance from water. Here its close superficial resemblance to the Isabelline Shrike, as it dashed across from one thicket to another, was particularly emphasized. Very skulking and secretive, especially when moulting; also silent, only occasionally uttering a harsh characteristic *ke*. Spasmodic bursts of song were heard on April 22.

Acrocephalus dumetorum Blyth. Blyth's Reed Warbler.

Specimens collected: Gujarat: SD300 ♂, SD301 ♂, SD302 ♂ 14-3-48 Mahal (Surat Dangs).

Elsewhere not noted.

Measurements :	W	B	Tar.	T
3 ♂♂	63–64	17–18	22–23	51–54

Winter visitor. Curiously enough not met with at all in Kutch, Saurashtra or elsewhere in Gujarat between August and end April.

Acrocephalus agricola agricola Jerdon. The Paddyfield Warbler.

Specimens collected: Kutch: KS352 ♀, KS353 ♂ 9-3-1944 Mandvi. Gujarat: GS114 ♂ 3-11-45 Ajwa (Baroda Dist.); GS240 ♂ 15-11-45 Baroda City environs; GS365 ♂ 22-11-45 Dabka (Baroda Dist.); GS437 ♂ 30-11-45 Cambay.

Elsewhere noted: Gujarat: Saiat (Kaira Dist.); Kharaghoda

Measurements:	W	B	Tar.	T
2 ♂♂	58–61	14–15	21·5–23	54–59
1 ♀	56	15	21	53

Fairly common winter visitor. Keeps within reeds bordering tanks and ponds, and permits a glimpse of itself only occasionally as it mounts to the top of a stem or dashes out in pursuit of a rival. Their presence however, is always advertised by the characteristic harsh *chrr . . chuck* they constantly utter. When flushed the bird skims over the sedges with a jerky hurried flight, spreading its tail as it dives into them again a few yards farther on. As it does so the rufous rump shows up prominently and discloses its identity.

Orthotomus sutorius guzurata (Latham). The Tailor Bird.

Specimens collected : Kutch : KS13 ♂ 8-8-1943 Rudra Mata (Bhuj Dist.). Gujarat: GS159 o? 7-11-45 Bodeli (Baroda Dist.); GS364 ♀ 22-11-45 Dabka (Baroda Dist.); GS1294 ♂ 19-4-46 Galkund; SD54 ♂ 27-2-48 Malegaon; SD122 ♂ 2-3-48 Galkund; SD243 ♀ 10-3-48 Laochali; SD334 ♀ 16-3-48 Mheskatri; SD403 ♀ 20-3-48 Sarwar (Surat Dangs). Saurashtra: B7 ♂ juv. 13-10-43 Dwarka (Okhamandal); GS981 ♂ 12-3-46 Kodinar; GS1006 ♀ 15-3-46 Dalkhania (Amreli Dist.)

Elsewhere noted : Kutch : Bhuj town and environs; Chaduva (Bhuj Dist.); Mandvi; Nakhatrana; Dhinodhar Hill; Bhachau; Rapar; Khavda, Nir and Kala Dongar (Pachham Island); Mata-no-Madh; Lakhpat; Dholovira (Khadir Island); Bela (Bela Island). Gujarat: Baroda City; Ajwa; Champaner (Panchmahals Dist.); Saiat, Dakor, Nadiad (Kaira Dist.); Patan (Mehsana Dist.); Palanpur town, Deesa, Balaram and Gangasagar (Palanpur); Rajpipla; Waghai (Surat Dangs). Saurashtra: Okha; Amreli; Dhari.

Measurements :	W	B	Tar.	T.
4 ♂♂	50–52	16–17·5	20–21·5	43·5–82
5 ♀♀	47–49	16–17	20–21	37·5–39

Resident. Common and generally distributed throughout the area. Affects gardens in towns, wooded compounds, stony scrub jungle as well as semidesert, but nowhere abundant. Solos or pairs usually met with.

The breeding season in Kutch is between June and August/September. Here, owing to the paucity of broad-leafed bushes the bird builds a nest of the *Cisticola* type, woven out of vegetable down with a number of narrow leaves sewed to it at the sides for support.

Prinia socialis stewarti Blyth. Stewart's Ashy Wren-Warbler.

Specimens collected : Gujarat: GS427 ♀ 29-11-45 Cambay; GS589 ♀, GS590 ♂, GS591 ♂ 16-12-45 Vaghjipur; GS748 ♂, GS749 ♂ 27-12-45 Patan (Mehsana Dist.); GS833 ♂ 5-1-46 Radhanpur. Saurashtra: GS978 ♂ Ghatwad (Kodinar).

Elsewhere noted : Deesa, Palanpur; Dediapada (Rajpipla).

Measurements :	W	B	Tar.	T
6 ♂♂	48–52	13·5–15	19·5–21	(60·5) 67–75
2 ♀♀	45·5–48	13–13·5	19·5	59–62·5

Affects reeds and herbage on the margins of streams and ponds. On the whole partial to better watered facies than the Indian Wren-Warbler, though in tall grass-Capparis-Salvadora thickets separating sandy fallow fields in the Radhanpur area the two species were often found together and in association with *Prinia buchanani* and *Chrysomma sinense*. All specimens collected during December were completing wing and tail moult into winter plumage.

Prinia inornata terricolor (Hume). The Indian Wren-Warbler.

Specimens collected: Kutch: KS4 ♂+ 8-8-43 Rudra Mata (Bhuj Dist.); KS151 ♂+ 3-9-43 Nakhatrana; KS241 ♂+ 17-9-43 Bhachau. Gujarat: GS328 ♀ 20-11-45 Dabka (Baroda Dist.); GS426 ♀ 29-11-45 Cambay; GS466 ♂, 3-12-45, GS487 o? 4-12-45 Golana (Cambay); GS540 ♂, GS541 ♀, GS542 ♂ 11-12-45 Nadiad (Kaira Dist.); GS658 ♂ 19-12-45 Vaghjipur, GS702 o? 24-12-45, GS729 o? 26-12-45 Patan (Mehsana Dist.); GS795 ♂, GS796 o? 1-1-46 Radhanpur. Saurashtra: GS977 o? 11-3-46 Ghatwad; GS982 ♀ 12-3-46 Kodinar; B34 ♂+ 18-10-43 Amreli.

Measurements:	W	B	Tar.	T
4 ♂♂ Summer (breeding)	50–54	12–13·5	19–21	49–56
5 ♂♂ Winter	50–54	12–13·5	20–21·5	59–76
5 ♀♀ Winter	48–50	12–13	19·5–21	64–69

A common, resident and widely-distributed species which, though frequently found in well-watered facies alongside the Ashy Wren-Warbler, is more tolerant of arid conditions, often being met with far out in sandy or stony semidesert. Breeding was in progress Kutch during August. Several nests with clutches of 3–5 eggs were seen, as also wobbly young just out of nest being fed and fussed over by the parents.

Prinia sylvatica gangetica (Blyth). The Jungle Wren-Warbler.

Specimens collected: Kutch: KS5 ♀+ 8-8-43 Bhuj; KS75 ♂+ 17-8-43 Chaduva; KS150 o? juv. 3-9-43, KS164 ♂ juv. 5-9-43 Nakhatrana; KS284 ♂ juv., KS285 ♂ juv. 28-9-43 Bhujia Fort; KS372 ♂ 15-3-44 Jakhau. Gujarat: GS292 ♂, GS293 ♂, GS294 ♀, GS295 ♀ 19-11-45 Dabka (Baroda Dist.); GS524 ♂ 9-12-45 Nadiad (Kaira Dist.); GS579 ♂ 15-12-45, GS599 o? 16-12-45 Vaghjipur (Mehsana Dist.); GS1113 ♂ 26-3-46 Rajpipla; SD186 ♂, SD187 ♀ 6-3-48 Pandwa (Surat Dangs). Saurashtra: GS1004 o? 15-3-46 Dalkhania (Amreli Dist.).

Elsewhere noted: Gujarat: Palanpur. Saurashtra: Kodinar.

Measurements:	W	B	Tar.	Winter T
8 ♂♂ ad.	62–65	15–17	(21) 23·5–25·5	74–89
3 ♀♀ ad.	53–56	14·5	22–25	71–77

Whistler (*Spolia Zeylanica*, 23: 178) says that *P. s. valida* of Ceylon differs from *P. s. sylvatica* of India among other things by its larger bill (12 ♂♂ *valida* 15·5–17 mm; 12 ♂♂ *sylvatica* 13–15 mm). I measure the 8 Gujarat males bill 15–17, but have seen no Ceylon specimens, and it is possible that bills of *valida* are sensibly larger otherwise than in length alone.

Fairly common in stony, hummocky grass-and-Euphorbia scrub country, cut up by eroded ravines. Breeding was in full swing in Kutch during August. The male sings excitedly both from bushtops and during the aerial courtship display which consists of a succession of quick-repeated nose-dives, the bird tumbling headlong groundwards, then rising steeply again for the next dive, and so on, till he finally alights on a nearby bush. The song is a lively but unmusical *p'ty*, *p'ty*, *p'ty*, etc. While being uttered, whether from a perch or in the air, the tail is spread to show off the white outer feathers prominently. The mouth in breeding males is jet black and easily noticed in the singing bird.

In the fluffy juvenile plumage there is a distinct primrose yellow wash on the under parts.

Prinia lepida Blyth. The Indian Streaked Wren-Warbler.

Specimens collected: Kutch: KS106 ♂ juv., KS107 ♂+ 24-8-1943, KS363 ♀ 12-3-44 Mandvi; KS337 o? 6-3-44 Devisar Tank (Bhuj Dist.). Gujarat: GS464 ♂, GS465 ♀ 3-12-45, GS477 ♂ 4-12-45 Golana (Cambay).

Elsewhere noted: Kutch: Khavda, Nir, Bela, Dholovira (all along edge of Great Rann); Pung Bet (Little Rann.)

Measurements :	W	B	Tar.	T
2 ♂♂	45–46	12 (1)	16·5–18	72 (1)
2♀♀	43–44	11–11·5	16·5–17·5	59–60·5

Resident. Affects sandy semidesert country with khip scrub (*Leptadenia*) and coarse grass tussocks among the sand dunes. Also scanty thorn scrub and grass country about cultivation and sandy dry nullahs. Flushes from cover like *Cisticola* and settles on a grass stem after a short jerky undulating flight characteristic of the wren-warblers. Has a wheezy unmusical warbling song of the Indian Wren-Warbler pattern.

Breeding was in progress in Kutch during July and August, and also in March. In the fresh juvenile there is a distinct yellow tinge on the sides of the neck and upper breast which appears to have been overlooked in published descriptions.

Prinia gracilis gracilis (Franklin). Franklin's Wren-Warbler.

Specimens collected: Kutch: KS6 ♂, KS7 ♂ 8-8-43 Rudra Mata (Bhuj Dist.) KS152 ♂ 3-9-43 Nakhatrana; KS377 ♂ 17-3-44 Mata-no-Madh; KS426 ♂ 31-3-44 Bhuj. Gujarat: GS275 ♂ 17-11-45, GS327 ♂ 20-11-45 Dabka (Baroda Dist.); GS587 ♂ 15-12-45; GS630 ♂ 18-12-45 Vaghjipur (Mehsana Dist.) SD76 o? 28-2-48 Malegaon; SD207 ♀, SD208 ♀ 7-3-48 Pandwa; SD271 ♂, SD272 ♂ 12-3-48 Laochali; SD333 ♀ 16-3-48, SD355 ♀ 17-3-48 Mheskatri (SD = Surat Dangs). Saurashtra: GS1020 ♂ 16-3-46 Dalkhania (Kodinar).

Elsewhere noted: Gujarat: Baroda City & environs; Champaner; Nadiad Saiat, Dakor (Kaira Dist.); Radhanpur; Balgram, Gangasagar, Hathidhara and Palanpur town environs; Juna Rajpipla; Saurashtra: Dhari (Amreli Dist.), Kodinar, Ghatwad; Kutch: Chaduva; Rapar.

Measurements :	W	B	Tar.	T
10 ♂♂	44·5–50·5 (average 47·8)	10·5–13	18–19·5	46–58 (summer & winter)
5 ♀♀	44–48 (average 46)	11·5–13	18–20	45–55 (winter)

In winter the tails in both sexes are considerably longer than in summer (breeding) plumage. Post-nuptial moult into winter plumage takes place about October.

Resident. Common and generally distributed. Frequents scrub jungle with coarse grass and thorn bushes—babul and *Salvadora* facies—in comparatively well-wooded country. In more open semidesert, in the Capparis–Zizyphus–coarse grass facies, e.g., about Patan in Mehsana Dist., it was completely replaced by *Prinia buchanani.* These two species appear to be ecological representatives of each other.

Over the greater part of our area the breeding season is from July to September. The nuptial display of the male is a lively and spirited performance. He mounts to an exposed perch on a bare tree- or bush-top and excitedly warbles a loud squeaky *yousee-yousee-yousee-which-which-which-which.* The *yousee* portion of it starts feebly, and is quickly repeated three or four times. It rises in pitch at each successive note and ends up loudly and abruptly after the third or fourth *which.* Another turn in the courtship proceedings consists of some spectacular aerobatics when the bird springs up in the air and executes a series of wave-crests and steep nose-dives in quick succession, to the accompaniment of the breeding song.

Prinia buchanani (Blyth). The Rufousfronted Wren-Warbler.

Specimens collected : Kutch : KS22 ♂, KS23 ♂ juv. 9-8-43, KS334 ♂ 5-3-44 Bhuj ; KS365 ♂ 12-3-44 Mandvi. Gujarat: GS700 ♂ 24-12-45, GS730 ♂ 26-12-45 Patan (Mehsana Dist.) ; GS759 ♀, GS760 ♂ 30-12-45 Radhanpur ; GS1042 ♀ 19-3-46, GS1070 ♀ 21-3-46 Kharaghoda. Saurashtra : GS1005 ♀ 15-3-46 Dalkhania (Kodinar).

Elsewhere noted : Kutch : Padhar, Chaduva (Bhuj Dist.) ; Nakhatrana ; Bhachau ; Rapar ; Khavda ; Nir ; Jakhau ; Mata-no-Madh ; Khadir Island. Saurashtra : Dhari (Amreli Dist.). Gujarat: Palanpur town & environs.

Measurements :	W	B	Tar.	T
5 ♂♂	52–55	12–13·5	18–19·5	(53)59–66
4 ♀♀	47–51	11·5–14	17–18·5	56–64·5

Resident. Affects dry sparsely scrubbed semidesert country—Capparis–Zizyphus–Prosopis–coarse grass facies—where it is common. My first meeting with it in Gujarat (at Patan) corroborated the floristic evidence of the desiccated nature of the terrain, as in Kutch ; and its gradual increase in northern Gujarat (e.g., Palanpur and Radhanpur) coincided with the increasing aridness, emphasized also by the appearance of such other typically semidesert birds as *Cursorius cursor*, and *Oenanthe isabellina.*

The habits of *Prinia gracilis* and *P. buchanani* differ noticeably in one particular. Whereas *buchanani* commonly hops about on the ground in amongst grass tussocks and thorn scrub, tail slightly cocked, *gracilis* hardly ever does so, being more arboreal and finding its food on the plants themselves. In the field the white tips of the rectrices show up prominently as a fringe when the tail is fanned out before the bird alights. In worn plumage, however, the tips become abraided and the bird then looks confusingly like the Indian Wren-Warbler (*Prinia inornata*). The rufous forehead alone (sometimes very faint) provides a clue to its identity.

Males mount to an exposed twig on a bushtop, with tail spread out and partially cocked, and pour forth a vehement reeling, twittering song. In overall pattern it is reminiscent of the song of the Ashy Wren-Warbler yet distinct enough to be quite unmistakable.

Nests with eggs and/or young, and other breeding activities, were observed in March as well as in August. The enlarged gonads of specimens likewise indicated that the season is a prolonged one.

Cisticola juncidis cursitans (Franklin). The Streaked Fantail Warbler.

Specimens collected: Kutch: KS66 ♂ 16-8-43 Chaduva (Bhuj Dist.); KS109 ♂, 24-8-43, KS349 o? 8-3-44 Mandvi. Gujarat: GS459 ♀ 2-12-45, GS461 ♀ juv., GS462 ♀, GS463 ♀ 3-12-45 Golana (Cambay); GS572 o? 12-12-45 Saiat (Kaira Dist.).

Elsewhere noted: Kutch: Godsar (Bhuj environs); Nakhatrana; Anjar; Pung Bet (Little Rann). Gujarat: Ajwa; Cambay town environs; Dakor (Kaira Dist.). Saurashtra: Dwarka (Okhamandal); Dhari (Amreli Dist.).

Measurements :	W	B	Tar.	T
2 ♂♂	52–54	10–10·5	19–20	31–34
4 ♀♀	45–48	11–12	17·5–18·5	38–42

Resident, but moves about locally with seasonal conditions—rain or drought—affecting its habitat. Inhabits patches of tall grass along the dry margins of tanks, lagoons, tidal creeks, etc. Breeding activity—zigzag 'chip-chipping' soaring display flight of males, nest building, feeding nest young, and wobbly stub-tailed juveniles ex nest—was in evidence between August and October.

Subfamily : TURDINAE

Erithacus svecicus pallidogularis (Saudrny). The Eastern Redspotted Bluethroat.

Specimens collected: Kutch: KS412 ♂ 26-3-44 Dholovira (Khadir Island); Gujarat: GS43 ♂ 30-10-45 Ajwa (Baroda Dist.); GS406 ♂ 28-11-45 Cambay; GS1039 o? 19-3-46 Kharaghoda. Saurashtra: B31 o? juv., B32 ♂ 18-10-43 Amreli.

Measurements :	W	B	Tar.	T
4 ♂♂	70·5–74	15–16	25–27	55–56

Erithacus svecicus abbotti (Richmond). The Eastern Whitespotted Bluethroat.

Specimens collected: Gujarat: GS14 ♀ 28-10-45 Ajwa (Baroda Dist.); GS332 ♂ 20-11-45 Dabka (Baroda Dist.); GS746 ♂ 27-11-45 Patan (Mehsana Dist.).

Elsewhere noted (races uncertain): Kutch: Chaduva; Rudra Mata; Devisar; Mandvi environs (e.g., Bamdai and Changdai tanks). Gujarat: Radhanpur; Palanpur; Viramgam. Saurashtra: Kodinar.

Measurements :	W	B	Tar.	T
2 ♂♂	76–77	15–15·5	25–26	59–61
1 ♀	71·5	15	28	55

Col. R. Meinertzhagen, who has been good enough to determine the Bluethroats collected by the Gujarat and Kutch Surveys, remarks about *E. s. abbotti*: 'This form is dimorphic, having usually a white spot but often a red spot on the blue. Upper parts darker than in *pallidogularis* but not so dark as in *saturatior*'.

Winter visitor. Earliest date October 18; latest March 19. Common and locally abundant among reedbeds and on marshy ground bordering jheels, sugar cane and lucerne fields, and other wet cultivation.

Erythropygia galactotes (Menetries). The Greybacked or Rufous Warbler.

Specimens collected: Kutch: KS133 ♂ 30-8-43, KS143 ♀, KS144 ♂, KS145 ♀ imm. 1-9-43 Bhuj; KS160 ♂, KS161 ♀ 5-9-43 Nakhatrana; KS177 ♂ 7-9-43 Bhuj; KS216 ♂ 14-9-43 Anjar; KS247 o? 20-9-43 Rapar. Saurashtra: B1 ♂ 12-10-43 Dwarka (Okhamandal).

Elsewhere noted: Kutch: Khari Rohar; Bhadreshwar; Bhachau; Khavda (Pachham Island); Kala Dongar; Nir; Kuar Bet.

Measurements:	W	B	Tar.	T
6 ♂♂	85·5–90 (average 87·6)	16–18	24–27	61–67
3 ♀♀	85–87 (average 86·3)	15–16	24–25	64–66

Autumn passage migrant en route to its winter quarters in Africa over the south-eastern tip of Arabia. Earliest date August 30; latest October 12. Peak between September 5 and 20 (1943). During this short period the birds were quite common, and all the specimens excessively fat. As in Sind, the return passage in spring evidently follows a different route, since none were observed again by the end of April, nor has it been recorded at that season.

Keeps singly to stony scrub-covered broken country, on the ground or in low bushes. Behaviour very robin-like. Hops along the ground with wings partly drooping at the sides, tail fanned out and cocked, and flicked up from time to time as in *Saxicoloides* or *Cyanosylvia*. When only a fleeting glimpse of the flying bird is obtained, confusingly like *Lanius isabellinus* or *L. phoenicuroides* except for the black and white tips to its rectrices which show up as a terminal fringe when the tail is spread on alighting, and are diagnostic.

Phoenicurus ochruros rufiventris (Vieillot). The Eastern Redstart.

Specimens collected: Gujarat: GS133 ♀, GS134 ♀ 5-11-45, GS166 ♂, GS167 ♀ 8-11-45, GS204 ♂, GS205 ♂ 10-11-45 Bodeli (Baroda Dist.). Saurashtra: B5 ♀ 13-10-43 Dwarka (Okhamandal); GS970 ♂ 11-3-46 Ghatwad (Kodinar).

Measurements:	W	B	Tar.	T
4 ♂♂	86–88	14·5–15·5	25–26	60–64·5
4 ♀♀	82–86	14–14·5	24–25	56–64·5

These specimens belong to the larger eastern race with blacker upper parts, and grey fringes to the feathers greatly reduced in the male. The females are darker with abdomen distinctly tinged with chestnut. 20 ♂♂ in the BNHS collection measure: W 85–93 (majority *over* 87 mm); 2 ♀♀ W 84–87 mm.

Phoenicurus ochruros phoenicuroides (Moore). The Kashmir Redstart.

Specimens collected: Kutch: KS182 ♂ juv. 8-9-43, KS271 o? 25-9-43 Bhujia Fort; KS279 ♂ 26-9-43, KS289 ♂ 28-9-43, KS336 ♂ 6-3-44 Bhuj environs ; KS404 ♀ 24-3-44 Chobari (Bhachau Dist.). Gujarat: GS631 ♀ 18-12-45 Vaghjipur, GS747 ♂ 27-12-45 Patan (Mehsana Dist.).

Elsewhere noted (subspecies ?): Kutch: Rapar ; Khavda ; Jakhau ; Lakhpat ; Dholovira ; Bela ; Adesar ; Chaduva. Gujarat: Champaner ; Baroda town and environs ; Dabka ; Kanewal (Cambay) ; Nadiad town and environs ; Radanpur ; Deesa ; Palanpur ; Dediapada (Rajpipla). Saurashtra: Amreli ; Dhari ; Kodinar Dalkhania.

Measurements :	W	B	Tar.	T
5 ♂♂	81–85	15–15·5	23–23·5	60–65
2 ♀♀	80–81	14·5–15·5	23–24	55·5–56

Specimens of this race in the BNHS collection measure : 23 ♂♂ W 81–87 (majority *under* 85 mm) ; 13 ♀♀ W 76–87 (majority *under* 85 mm).

An analysis of the Survey specimens shows that all birds north of a line from Dwarka through Baroda (i.e. *ca.* 20°30′N lat.) belong to the smaller western race *phoenicuroides* with broadly grey-fringed upper parts in male.

Winter visitor. Earliest date August 30 ; latest April 3. Fairly common and abundant. Solos. Affects stony scrub-covered broken country, dry watercourses, kandi and babul patches in semidesert, and the neighbourhood of villages and cultivation.

Copsychus saularis saularis (Linn.). The Indian Magpie Robin.

Specimens collected : Gujarat: GS359 ♂ 22-11-45 Ajwa (Baroda Dist.) ; GS391 ♂, GS392 ♀ 28-11-45 Cambay : GS1196 ♂ 3-4-46 Dediapada (Rajpipla) Saurashtra: GS979 ♂ 12-3-46 Kodinar (Amreli Dist.).

Elsewhere noted: Gujarat: Baroda City and environs ; Dabka Nadiad town and environs ; Vaghjipur and Patan (Mehsana Dist.) ; Radhanpur ; Palanpur ; Deesa ; Rajpipla ; Waghai (Surat Dangs) etc. Saurashtra: Dhari (Amerli Dist.) ; Ghatwad (Kodinar), etc.

Absent in Kutch.

Measurements :	W	B	Tar.	T
4 ♂♂	96·5–105	21–23	30–31·5	84–93
1 ♀	96	20	30	82

Resident. Common. Males in full song in March/April, and evidently breeding in the latter month.

Copsychus macrourus malabaricus (Scopoli). The Shama.

Specimens collected : Gujarat: GS1245 ♂ 12-4-46 Waghai (Surat Dangs).

Elsewhere not noted.

Measurements :	W	B	Tar.	T
1 ♂	98	21	26·5	156

A few examples were observed in this locality (Surat Dangs) in mixed deciduous bamboo and teak forest.

Saxicoloides fulicata cambayensis (Latham). The Brownbacked Indian Robin. (Local name in Palanpur *Deoli*).

Specimens collected : Kutch: KS128 ♂ juv. 30-8-43, KS134 ♂ 31-8-43 Bhuj. Gujarat: GS90 ♂ 1-11-45 Ajwa (Baroda Dist.); GS446 ♀, GS447 ♂, GS448 ♂, GS449 ♂, GS450 ♂ 1-12-45, GS503 ♀ 7-12-45 Cambay; GS884 ♂ 11-1-46, GS894 ♀, GS895 ♂ 12-1-46 Deesa (Palanpur); GS1078 ♂ 21-3-46 Kharaghoda.

Elsewhere noted: Kutch: Kandla; Padhar; Chaduva; Nakhatrana; Bhachau; Khavda; Kala Dongar; Mata-no-Madh; Dholovira; Bela; Adesar, etc. Gujarat: Dabka; Vaghjipur; Patan; Harij; Radhanpur; Rajpipla; Waghai (Surat Dangs), etc. Saurashtra: Dwarka: Okha; Amreli; Dhari; Kodinar; Dalkhania, etc.

Measurements:	W	B	Tar.	T
9 ♂♂	73–78	14–16	25–28	65–72
3 ♀♀	71·5–73	14–15·5	25·5–26·5	61–65

Resident. Common. Breeding March to July/August. Complete post nuptial moult August/September.

Turdus simillimus mahrattensis Kinnear & Whistler. The Black-capped Blackbird.

Specimens collected: Gujarat: GS44 o? 30-10-45 Pavagadh (Panchmahals Dist.); GS408 o? 29-11-45, GS494 ♀, GS495 ♀ 6-12-45 Cambay; GS1106 ♂ 25-3-46 Juna Rajpipla; GS1209 ♂ 7-4-46 Medha (Navsari Dist.); GS1274 ♀ 16-4-46, GS1288 ♀, GS1289 ♀ 17-4-46 Mahal (Surat Dang); SD36 ♀, SD31 ♀ 25-2-48; SD71 ♂ 28-2-48 Malegaon (Surat Dangs).

Not met with in Saurashtra. Absent in Kutch.

Measurements:	W	B	Tar.	T
3 ♂♂	131–134	24·5–28	32–33	96–101
7 ♀♀	116–128	25–28	30–33	85–94

Winter visitor to the Gujarat plains. Affects secondary deciduous forest and scrub jungle. Capt. Butler (*SF*, iii : 470) notes that it breeds in considerable numbers at Mt. Abu (where it is absent during the cold weather) at the commencement of the trains. Presumably breeds in the other hills of the area also, e.g., Pavagadh and Salher. Even the April specimens showed no departure in the gonads from the quiescent non-breeding condition, though by the middle of that month occasional sub-song was heard.

Turdus citrina cyanotus Jard. & Selby. The Whitethroated Ground Thrush.

Specimen collected: Gujarat: GS1222 ♂ 8-4-46 Medha (Navsari Dist.).

Not noted elsewhere in Gujarat, or in Saurashtra. Absent in Kutch.

Measurements:	W	B	Tar.	T
1 ♂	119 (fresh) 116 (dry)	22	33	79

In the Eastern Ghats Survey (*JBNHS*, 36 : 79) Whistler measures 7 ♂♂ Wing 109–112·5 (dry). F.B.I. (ii : 150) gives the wing ♂♀ as 106-112 mm.

Status ? The above was the sole example met with by the Surveys. Solo in thickets by a pool in the bed of a forest stream. Silent.

Monticola soiltarius pandoo (Sykes). The Blue Rock Thrush.

Specimens collected: Gujarat: GS175 ♂ 9-11-45 Bodeli (Baroda Dist.); GS246 ♀ 17-11-45, GS277 ♂ 18-11-45 Dabka (Baroda Dist.); GS929 ♂ 18-1-46 Balaram (Palanpur); GS1128 ♂ 27-3-46 Juna Rajpipla; SD362 ♂ 18-3-48 Mheskatri (Surat Dangs). Saurashtra: B41 ♂, B42 ♀ 20-10-43 Dhari (Amreli Dist.).

Elsewhere noted: Kutch: Rapar; Mata-no-Madh; Bhuj & environs; Adesar. Gujarat: Champaner (Panchmahals); Deesa (Palanpur); Waghai (Surat Dangs).

Measurements:	W	B	Tar.	T
5 ♂♂	116–124	27–28	27–29	77–85
1 ♀	118	27·5	29	78

The two Saurashtra specimens are not included above. They seem exceptionally large.

♂	128	27·5	28	85·5
♀	121	26	28	82·5

In other respects they do not differ from the Gujarat series.

Ticehurst (*JBNHS*, 31: 494) gives the following measurements: *M. s. pandoo* Wing ♂ 117-123; *M. s. longirostris* (= *transcaspica*) W ♂ 121-127 mm.

Winter visitor. Earliest date September 21; latest April 11. One or two examples usually seen in its characteristic facies: rocky cliffs, boulder-strewn hillsides, quarries, walls and ramparts of ancient forts, and ruined buildings.

Monticola cinclorhyncha (Vigors). The Blueheaded Rock Thrush.

Specimens collected: Gujarat: SD66 ♂ 28-2-48 Malegaon; SD192 ♂, SD193 ♀ 6-3-48 Pandwa (Surat Dangs).

Elsewhere not noted in Gujarat, Saurashtra or Kutch.

Measurements:	W	B	Tar.	T
2 ♂♂	103·5–104	23–24	25–26	65
1 ♀	97	24	27	65

Winter visitor. Recorded by Butler at Mt. Abu (*SF*, iii: 470) but nowhere else in northern Gujarat. The Survey came across it in small numbers—solos or separated pairs—in forest country in the Dangs, and it presumably also occurs in similar terrain in the Rajpipla area.

Oenanthe isabellina (Cretzschm.) The Isabelline Chat.

Specimens collected: Kutch: KS224 ♂ 15-9-43 Anjar; KS245 ♂ 20-9-43 Rapar: KS288 ♀ 28-9-43 Bhuj environs. Gujarat: GS695 ♀ 24-12-45 Patan (Mehsana Dist.); GS800 ♂, GS801 ♂, GS802 ♂, GS803 ♀, GS804 ♂ 1-1-46 Radhanpur; GS920 ♂ 14-1-46 Deesa (Palanpur).

Elsewhere noted: Saurashtra: Amreli. Kutch: Jakhau.

Measurements:	W	B	Tar.	T
7 ♂♂	98–104	18–19·5	30–31·5	56–62
3 ♀♀	92·5–96	19·5–20	28·5–30	51·5–55

Winter visitor. Earliest date September 15; latest March 15. Not uncommon in Kutch and the semidesert portions of northern Gujarat.

Affects the same facies as *Cursorius cursor*, *Oenanthe deserti*, *Oe. opistholeuca* etc.—open sandy semidesert and waste land with sparse *Capparis*, babul, *Alhagi maurorum* and such-like bushes.

In the field this chat may be distinguished from female *Oe. deserti* by its plumper build, heavier head, longer legs and absence of black in the upper wing coverts. In flight the white subterminal band to the tail is noticeably broader and more glistening white against buffy white in *deserti*.

Oenanthe deserti atrogularis (Blyth). The Desert Chat.

Specimens collected: Kutch: KS225 o? 15-9-43 Anjar; KS296 ♂, 1-10-43, KS302 ♂, KS303 ♂ Khavda (Pachham Island). Gujarat: GS192 ♂ 8-11-45 Bodeli (Baroda Dist.); GS282 ♂, GS283 ♂ 18-11-45 Dabka (Baroda Dist.); GS444 ♂ 30-11-45 Baduchi (Cambay); GS581 ♀ 15-12-45, GS601 ♂ 16-12-45 Vaghjipur (Mehsana Dist.); GS692 ♂, GS693 ♀, GS694 ♀ 24-12-45, GS752 o? 28-12-45 Patan (Mehsana Dist.).

Elsewhere noted: Kutch: Khari Rohar; Nanda (SW. of Adesar); Pung Bet (Little Rann); Mandvi; Jakhau; Mata-no-Madh; Lakhpat. Saurashtra: Dwarka; Amreli; Kodinar. Gujarat: Golana (Cambay); Radhanpur; Deesa (Palanpur).

Measurements:	W	B	Tar.	T
10 ♂♂	94–99	16·5–19·5	25–27	62–69
4 ♀♀	88–94	16·5–17·5	26–26·5	54–62

Winter visitor. Earliest date September 15; latest March 18. Fairly common. Solos or pairs on semidesert waste land, often along with other chats and Short-toed Larks.

Oenanthe xanthoprymna chrysopygia (De Fil.). The Redtailed Chat.

Specimens collected: Kutch: KS297 ♂ 1-10-43, KS300 ♀, KS301 ♀ Khavda (Pachham Island); KS387 ♂ 18-3-44 Lakhpat.

Elsewhere noted: Kutch: Nir & Kala Dongar (Pachham Island); Dholovira & Chhaparia Hills (Khadir Island). Gujarat: Patan (Mehsana Dist.).

Measurements:	W	B	Tar.	T
2 ♂♂	92·5–93	18	25·5–26	56·5–60
2 ♀♀	92	18–20	24·5–26·5	59–60

Winter visitor. Earliest date October 1; latest March 26. Not uncommon in its characteristic biotope and facies: semidesert, flat stony and sandy 'kallar' land with sparse *Capparis* and other bushes—especially in the tract known as Banni in northern Kutch and along the edge of the Great Rann. Almost everywhere in food competition with *Oenanthe picata* by which it was being constantly chivvied and chased about.

Hume (*SF*, iii, 476) records specimens from the base of Mt. Abu in N. Gujarat and from Morvi in Saurashtra.

Oenanthe picata (Blyth). The Pied Chat.

Specimens collected: Kutch: KS37 ♂, KS38 ♀ imm. 11-8-43 Bhujia Fort; KS126 ♀ 30-8-43 Devisar Tank (Bhuj Dist.); KS131 ♀, KS132 ♀ juv. 31-8-43 Bhujia Fort; KS163 ♂ 5-9-43 Nakhatrana. Gujarat: GS285 ♀, 18-11-45 Dabka (Baroda Dist.); GS512 ♂ 8-12-45 Pariej (Kaira Dist.); GS696 ♂ 24-12-45, GS712 ♀ 25-12-45, GS733 ♀ 26-12-45 Patan (Mehsana Dist.); GS799 ♀ 1-1-46, GS835 ♀ 5-1-46 Radhanpur; GS856 ♂, GS857 ♀ 9-1-46 Deesa (Palanpur); GS922 ♀ 16-1-46 Palanpur; GS1063 ♂ 20-3-46 Kharaghoda.

Elsewhere noted: Kutch: Kandla; Mandvi; Chaduva; Bhachau; Rapar; Khavda; Nir; Jakhau; Mata-no-Madh; Chobari; Dholovira; Adesar, etc. Saurashtra: Dwarka; Amreli; Kodinar; Dalkhania; Navalkhi (Morvi); Veraval (Junagadh).

Measurements:	W	B	Tar.	T
5 ♂♂	90–96	15–17	25–25·5	64–68
12 ♀♀	86·5–95	14–18·5	22–26	57–67

It is now established that this is a polymorphic species and that *Oenanthe opistholeuca* and *Oe. capistrata* (infra) are merely colour phases of it. The females of *Oe. picata* and what was heretofore called *Oe. capistrata* are usually identical in appearance, even in the hand, though sometimes the latter's throat is a shade darker. They are seen paired with males either of the true *picata* type or with '*capistrata*' or '*opistholeuca*'.

The *picata* colour phase is far commoner than either *capistrata* or *opistholeuca*.

Winter visitor. Very common and abundant in Kutch and the semi-desert western portions of N. Gujarat. Earliest date August 5; latest March 20. Individuals have fixed feeding territories which are jealously guarded against intrusion particularly of chats of the same or other species with similar feeding habits. Has a pretty song (on first arrival in winter quarters) something like the Magpie Robin's. The bird is also a good mimic, and I have heard it taking off to perfection, among others, the Common Babbler, Indian Wren-Warbler, Tailor Bird, Redwattled Lapwing and Spotted Owlet; also the twittering song of the Swallow, and the musical soliloquy of the Rufousbacked Shrike.

Oenanthe capistrata (Gould). The Whiteheaded Chat.

No specimens obtained. A single male observed at Patan, Mehsana Dist., (24-12-45) in sandy fallow country sparsely dotted with *Capparis* and stunted babul bushes. Exactly like *Oe. picata* but with the crown and nape white.

Oenanthe opistholeuca (Strickland). Strickland's Chat.

Specimens collected: Kutch: KS299 ♂ 2-10-43 Khavda (Pachham Island). Gujarat: GS147 ♀ 6-11-45 Bodeli (Baroda Dist.); GS866 ♂ 10-1-46, GS833 ♂ 11-1-46 Deesa (Palapur).

Measurements:	W	B	Tar.	T
3 ♂♂	93–95	17–17·5	25–25·5	64–66
1 ♀	90	17	23·5	62

In what has hitherto been considered this 'species' the adult female is very like the adult male, but *sooty* black (or dark brown) where he is jet black. It is unmistakable with females of the normal *Oe. picata* phase or with those considered typical of *Oe. capistrata.*

Both the above colour phases of *Oe. picata* are much less common than *picata* itself. For some reason, I always found them inordinately wild—far more so than *picata.*

Cercomela fusca (Blyth). The Brown Rock Chat.

Specimens collected : Kutch: KS18 ♀, KS19 ♂ 9-8-43 Bhujia Fort; KS33 ♂ 10-8-43 Tapkeshwari (Bhuj environs); Gujarat: GS867 ♀, GS868 ♂, GS869 ♂ 10-1-46 Deesa (Palanpur); GS934 ♀ 18-1-46 Gangasagar (Palanpur).

Elsewhere noted : Kutch: Rapar ; Kala Dongar (Pachham) ; Naliya (Jakhau Dist.) ; Mata-no-Madh.

Measurements :	W	B	Tar.	T
4 ♂♂	87–95	18·5–19·5	25–27	65–71·5
3 ♀♀	85·5–90	17·5–19	25–25·5	61–69

Very worn plumage in August.

Resident. Not uncommon in Kutch about boulders and scarps in rocky hills, ancient ruined forts, etc. In Gujarat only met with in the Palanpur area in similar facies (e.g., Bhakhar Hill, near Deesa). Evidently the principal breeding months in Kutch are June to August.

Saxicola caprata bicolor (Sykes). The Northern Indian Pied Bushchat.

Specimens collected : Kutch: KS229 o?, KS230 o? juv. 15-9-43 Anjar ; KS283 ♂ 27-9-43 Bhuj ; KS348 ♀ 8-3-44 Mandvi. Gujarat: GS12 ♂ 28-10-45, GS30 ♂ 29-10-45 Ajwa (Baroda Dist.) ; GS158 ♀ 7-11-45 Bodeli (Baroda Dist.) ; GS350 ♂ 21-11-45 Dabka (Baroda Dist.) ; GS380 ♂ 27-11-45 Cambay ; GS435 ♂ 30-11-45 Baduchi (Cambay) ; GS456 ♀ 2-12-45, GS467 ♀ 3-12-45 Golana (Cambay) ; GS513 ♂ 8-12-45 Pariej (Kaira Dist.) ; GS836 ♀ 5-1-46 Radhanpur. Saurashtra: B28 ♂ 17-10-43, B37 ♂ 18-10-43 Amreli.

Elsewhere noted : Kutch: Pung Bet (Little Rann). Gujarat: Saiat and Dakor (Kaira Dist.) ; Patan and Harij (Mehsana Dist.) ; Deesa (Palanpur) Saurashtra: Dhari (Amreli) ;

Measurements :	W	B	Tar.	T
9 ♂♂	69·5–77	13–15	19·5–24·5	50–55
5 ♀♀	70–75·5	12·5–15	19·5–23	49–53

Evidently a winter visitor, the first and last dates being September 15 and March 8. Fairly frequent though not common in Gujarat, less common in Saurashtra and decidedly uncommon in Kutch. Seen on reeds and bushes, particularly in the vicinity of tanks and jheels.

Saxicola caprata atrata (Blyth). The Southern Indian Pied Bushchat.

Specimens collected : Gujarat: SD223 ♂+, SD224 ♂+ 7-3-48 Salher *ca.* 2,000 ft. (Navsari Dist.).

Measurements :	W	B	Tar.	T
2 ♂♂	72–73	14	21·5–22·5	50–51

The resident race. Fairly common in the broken, undulating country about the base or Fort Salher in March. Males in full song and in possession of jealously guarded territories. Breeding was either in progress or imminent. Gonads of the specimens 6 × 3 and 7 × 4 mm.

Saxicola torquata indica (Blyth). The Indian Collared Bushchat.

Specimens collected : Kutch : KS347 ♂ 8-3-44 Mandvi. Gujarat: GS6 ♂, GS7 ♀ 28-10-45 Ajwa (Baroda Dist.); GS457 ♂ 2-12-45 Golana (Cambay); GS528 ♂ 9-12-45 Nadiad (Kaira Dist.); GS798 ♂ 1-1-46 Radhanpur ; GS923 ♂ 16-1-46 Palanpur ; SD286 ♀ 12-3-48 Laochali (Surat Dangs). Saurashtra: B6 ♂ 13-10-43 Dwarka ; B43 ♀ 20-10-43 Dhari (Amreli Dist.); GS1008 ♂ 15-3-46 Dalkhania (Amreli Dist.).

Elsewhere noted : Kutch : Pung Bet (Little Rann). Gujarat; Dabka ; Pariej, Dakor (Kaira Dist.); Patan (Mehsana Dist.); Rajpipla ; Dediapada, Ghatoli (Rajpipla). Saurashtra: Muldwarka ; Kodinar.

Measurements :	W	B	Tar.	T
8 ♂♂	68–72	13–14	21–23	46–51
3 ♀♀	66–68·5	13–14·5	21–22·5	44·5–46·5

Winter visitor. Earliest date October 12 ; latest April 2. Not common, but quite frequent. Singly or separated pairs about reed beds bordering tanks, and sparse scrub around fallow fields. Also amongst sand dunes near the sea-shore with sparse scrub of khip (*Leptadenia spartium*), etc. Often in the same facies as the Pied Bushchat.

Myiophoneus horsfieldi Vigors. The Malabar Whistling Thrush.

Specimen collected : SD174 ♂ 6-3-48 Pandwa (Surat Dangs).

Elsewhere noted only in the Surat Dangs, at Waghai.

Measurements :	W	B	Tar.	T
1 ♂	158	32	49	107

Doubtless resident, but not common. In song on 25 March, 6-15 a.m.

Family MOTACILLIDAE : Wagtails, Pipits

Anthus hodgsoni hodgsoni Richmond. The Indian Tree Pipit.

Specimen collected : Gujarat : GS1277 ♀ 16-4-46 Mahal (Surat Dangs).

Measurements :	W	B	Tar.	T
1 ♀	85	14	20·5	61·5

In my experience uncommon. Capt. Butler (*SF*, iii : 490) apparently obtained specimens in the Deesa neighbourhood and describes it as common in N. Gujarat in winter, arriving about September 5.

The specimen was excessively fat, and doubtless ready to emigrate.

Anthus trivialis trivialis (Linn.). The Tree Pipit.

Specimens collected : Gujarat : GS103 ♂, GS104 ♀, GS105 ♂ 2-11-45 Ajwa (Baroda Dist.); GS289 o? 18-11-45 Dabka (Baroda Dist.); GS405 ♀ 28-11-45 Cambay ; GS469 ♀ 3-12-45 Golana (Cambay); GS619 ♂ 17-12-45 Vaghjipur (Mehsana Dist.); GS1219 ♂ 8-4-46 Songadh (Navsari Dist.); SD17 ♀ 23-2-48, SD25 ♂ 25-2-48, SD70 ♂ 28-2-48, SD88 ♂, SD89 ♂ 29-2-48, SD147 ♀ 4-3-48, SD157 ♂ 5-3-48 Pandwa ; SD375 ♂, SD376 ♂, SD377 o? 19-3-48 ; SD379 ♂, SD380 ♂ 20-3-48 Sarwar ; SD458 ♂ 25-3-48 Chikhli (SD = Surat Dangs): Saurashtra : B50 o? imm., B51 o? imm. 20-10-43 Dhari (Amreli Dist.); GS1001 ♂ 15-3-46 Dalkhania (Amreli Dist.).

Measurements :	W	B	Tar.	T
12 ♂♂	85–94	13·5–15·5	20–22·5	61–68
3 ♀♀	84·5–88	13·5–15	21	59–63

All the above are *trivialis*, but if one chooses to recognise *haringtoni* on the basis of greater breadth of bill at the base, perhaps Nos. GS104, GS469 and GS1219, *could* pass for that form. I am inclined to agree with Col. Meinertzhagen, however, that *haringtoni* is not a good race, the breadth and depth of bill at base being a most variable character. In any case it is inadequate by itself for identifying winter birds.

Winter visitor. Rare in Kutch; common and abundant in Gujarat and Saurashtra. Earliest date September 9 (Kutch); latest April 19 (Surat Dangs). All specimens after February 23 were in varying stages of body moult, and fat to excessively fat showing that they were ready to emigrate.

Anthus sordidus jerdoni (Finsch). The Brown Rock Pipit.

Specimens collected : Kutch : KS325 ♂, KS326 ♀ 6-10-43 Bhachau ; KS358 ♀ 10-3-44, KS361 ♂, KS362 ♂ 12-3-44 Mandvi ; KS415 ♀ 26-3-44 Dholovira (Khadir Island); Gujarat: GS8 o? 28-10-45, GS106 ♂, GS107 ♀ 2-11-45 Ajwa (Baroda Dist.); GS237 ♀, GS238 ♀ 15-11-45 Baroda City environs. Saurashtra : B2 ♂ 12-10-43, B14 ♂ 14-10-43 Dwarka.

Measurements:	W	B	Tar.	T
5 ♂♂	98–105	19·5–20·5	28–30	80–91
5 ♀♀	95–99	18·5–21	28–29·5	80–88

The Perso-Baluchi race *A. s. decaptus* also occurs in India during winter and may then be easily confused with this. It is, however, paler below not so reddish.

Status ? Not uncommon. Solos or loose parties of 3 or 4 on rocky, sparsely scrubbed hummocky ground, and sand dunes near the sea coast (e.g. Mandvi).

Anthus richardi godlewskii (Taczanowski). Blyth's Pipit.

Specimen collected : Saurashtra : B12 ♂ 13-10-43 Dwarka (Okhamandal).

Measurements:	W	B	Tar.	T
1 ♂	85	16	28	62

Several scattered individuals on the grassy margin of a tank at Mithapur.

(The identity of this specimen is not undoubted. It seems rather small for *godlewskii* and may only be *rufulus* !)

Anthus richardi rufulus Vieillot. The Indian Pipit.

Specimens collected : Kutch : KS51 ♂ 12-8-43 Bhuj ; KS194 o? imm. 9-9-43 Ratnal ; KS249 o? imm. 20-9-43 Rapar ; KS332 ♀ 5-3-44 Bhuj ; KS359 ♀, KS360 ♀ 10-3-44 Mandvi. Gujarat: GS9 ♂ 28-10-45 Ajwa (Baroda Dist.) ; GS195 ♂ 9-11-45 Bodeli (Baroda Dist) ; GS470 ♂ 3-12-45 Golana (Cambay) ; GS705 ♂ 24-12-46 GS745 ♂ 27-12-45, Patan (Mehsana Dist.).

Measurements :	W	B	Tar.	T
6 ♂♂	84–87	16–16·5	26·5–27·5	60–63
3 ♀♀	84–85	17	25	65

The Kutch specimens approximate to the pale race *waitei* of Sind and NW. India.

A common resident species, usually seen in pairs or scattered parties of 3 or 4 on fallow land, ploughed fields, etc.

Anthus campestris griseus Nicoll. The Eastern Tawny Pipit.

Specimens collected : Kutch: KS165 ♂, KS166 ♂, KS167 ♂ imm., KS168 ♂ 6-9-43 Nakhatrana ; KS179 o? 7-9-43 Bhuj ; KS242 o? 18-9-43 Bhachau ; KS248 ♂ 20-9-43 Rapar ; Gujarat : GS 196 ♀ 9-11-45 Bodeli (Baroda Dist.) ; GS262 ♂ 17-11-45 Dabka (Baroda Dist.); GS536 ♂ 10-12-45 Nadiad (Kaira Dist.) ; GS618 ♀ 17-12-45 Vaghjipur (Mehsana Dist.); GS697 ♂ 24-12-45, GS731 ♂ 26-12-45, GS751 ♂ 28-12-45 Patan (Mehsana Dist.) ; GS757 ♂, GS758 ♂ 30-12-45, GS805 ♀, GS806 ♀ 1-1-46, GS834 o? 5-1-46 Radhanpur ; GS850 ♂ 9-1-46 Deesa (Palanpur) ; GS1058 ♀ 20-3-46 Kharaghoda. Saurashtra : B8 ♂, B9 ♂, B10 ♀ 13-10-43, B19 ♂ 14-10-43 Dwarka (Okhamandal) ; B38 ♂, B39 ♂ 17-10-43 Amreli ; GS1021 ♂ 16-3-46 Dalkhania (Amreli Dist.).

Measurements :	W	B	Tar.	T
21 ♂♂	89·5–95	14·5–18·5	24·5–27·5	65–76 (78·5)
5 ♀♀	85–88	16–17·5	24-25·5	65–70

Winter visitor. Common and abundant. Earliest date September 6 (Kutch) ; latest March 20 (Kharaghoda).

In loose parties and flocks in semidesert and on fallow land near cultivation. In flight, silhouetted against the sky, easily confused with the Greynecked Bunting (*Emberiza buchanani*) with which it frequently associates. It has the same white in the outer rectrices visible before it alights. The great preponderance of males over females in the specimens collected is noteworthy.

Anthus rufogularis Brehm [=*A. cervinus* (Pallas)]. The Redthroated Pipit.

Specimen collected : Gujarat : GS239 o? 18-11-45 Dabka (Baroda Dist.).

Measurements :	W	B	Tar.	T
1 o?	87	15	22	65

Status ? The only example of this species among the large number of pipits collected by the surveys.

Anthus roseatus Hodgs. Hodgson's Pipit.

I have examined two specimens (♂ ♀) collected by K. S. Dharmakumarsinhji on 3-4-51 at Gaurishankar Lake in Bhavnagar (Saurashtra). This marks the most southerly point at which the specie has occurred in India. Satanwara in Gwalior (Madhya Bharat) was previously the southernmost record (*JBNHS*, 41 : 105).

Several pipits were observed on 18-3-46 at the tank in Viramgam (Gujarat) which by their heavily black-streaked undersides suggested

Anthus spinoletta. No specimens could be collected. This species has not been recorded in Kutch, Saurashtra or the N. Gujarat plains previously, but Hume (*SF*, iii : 491) procured it on the slopes of Mt. Abu, *ca.* 1870.

Motacilla flava thunbergi Billberg. The Greyheaded Yellow Wagtail.

Specimens collected: Kutch: KS130 o? imm. 30-8-43 Bhuj environs; Gujarat: GS42 ♀ 30-10-45 Ajwa (Baroda Dist.); GS178 ♀ 9-11-45 Bodeli (Baroda Dist.); GS616 ♂ 17-12-45 Vaghjipur (Mehsana Dist.).

Measurements :	W	B	Tar.	T
1 ♂	81	15	23·5	71·5
2 ♀♀	77–80	16	23·5–25·5	70–71

Motacilla flava beema Sykes. The Blueheaded Yellow Wagtail.

I have examined two specimens of this race in summer plumage collected by K. S. Dharmakumarsinhji at Gaurishankar Lake, Bhavnagar (Saurashtra) on 3-4-1951.

Motacilla flava melanogriseus (Homeyer). The Turkestan Blackheaded Wagtail.

Specimens collected: Kutch: KS376 ♂ 15-3-44 Jakhau; KS414 ♂ 26-3-44 Dholovira (Khadir Island).

Measurements :	W	B	Tar.	T
2 ♂♂	79	17–18	22·5–24	70–72·5

Both in heavy body moult into black-headed summer plumage. Met with on muddy grassy tank margins.

Motacilla citreola citreola Pallas. The Greybacked Yellowheaded Wagtail.

Specimens collected: Kutch: KS392 ♂ 21-3-44 Bhuj environs Gujarat: GS15 ♂ 28-10-45 Ajwa (Baroda Dist.); GS705 ♂ 24-12-45 Patan (Mehsana Dist.); GS1036 o? 19-3-46 Kharaghoda.

Measurements :	W	B	Tar.	T
3 ♂♂	82–86	16–17	24–25·5	71·5–75

Motacilla citreola werae Buturlin. The Blackbacked Yellowheaded Wagtail.

Specimens collected: Gujarat: GS141 ♂, GS142 ♂ 6-11-45 Bodeli (Baroda Dist.); GS436 ♂ 30-11-45 Baduchi (Cambay); GS616 ♂, GS617 ♂, 17-12-45 Vaghjipur (Mehsana Dist.); GS1035 ♂ 19-3-46 Kharaghoda.

Measurements :	W	B	Tar.	T
6 ♂♂	81–85	15–17	23–26	69–74·5

Winter visitors. Fairly common, the two races often together, on marshy margins of tanks, inundated fields, etc. Earliest date October 3 (Khavda, Kutch); latest April 22 (Pachham Island, Kutch, and Galkund, Surat Dangs).

Motacilla cinerea melanope Pallas. The Eastern Grey Wagtail.

Specimens collected : Kutch : KS231 ♀ 16-9-43 Anjar. Gujarat: SD90 o? 29-2-48, SD384 ♂ 20-3-48 Sarwar (Surat Dangs).

Measurements :	W	B	Tar.	T
1 ♂	82	17·5	21	90
1 ♀	84	15·5	19	87·5

Winter visitor. Earliest date September 16 (Kutch); latest April 19 (Surat Dangs).

Motacilla maderaspatensis Gmelin. The Large Pied Wagtail.

Specimens collected: Kutch: KS52 ♂ 12-8-43 Bhuj environs; KS222 ♂ 15-9-43 Anjar; Gujarat: GS169 ♀ 8-11-45 Bodeli (Baroda Dist.); GS669 ♂ 20-12-45 Vaghjipur (Mehsana Dist.).

Measurements :	W	B	Tar.	T
2 ♂♂	97·5–101	20–20·5	27–27·5	101–104
2 ♀♀	96–99	19–20	25·5–28	100

Resident. Local and uncommon in Kutch and Saurashtra, more generally distributed in Gujarat though nowhere abundant. A pair or so usually present on every rocky section of streams and rivers. Breeding was in progress in April (cf. Wiretailed Swallow).

Motacilla alba dukhunensis Sykes. The White Wagtail.

Specimens collected: Kutch: KS317 ♀ 4-10-43 Khavda. Gujarat: GS168 ♂, GS191 ♂ 8/9-11-45 Bodeli (Baroda Dist.); GS703 ♀, GS704 ♂ 24-12-45 Patan (Mehsana Dist.).

Measurements :	W	B	Tar.	T
2 ♂♂	94·5–95	15·5–16	24–25	89–96
1 ♀ (1st year)	84	15·5	20	84·5

Winter visitor. Common over the entire area. Earliest date August 24 (Mandvi, Kutch); latest April 22 (Nir, Pachham).

Solos or small scattered parties running about on lawns, playing fields and dry margins of tanks, etc.

Motacilla indica Gmelin. The Forest Wagtail.

Specimens collected: Gujarat: GS1270 ♂ 14-4-46 Waghai, SD432 ♀ 22-3-48 Pimpri (Surat Dangs).

Measurements :	W	B	Tar.	T
1 ♂	82	18	21	73
1 ♀	83	17	22	71

Winter visitor. Rare. Sporadic solos met with in moist deciduous biotope. Not observed elsewhere in the area, but possibly occurs in the Gir forest of Junagadh (Saurashtra). Contrary to what one would expect so late in the season, neither of the specimens was fat.

Family LANIIDAE

Subfamily : LANIINAE : Shrikes

Lanius excubitor lahtora (Sykes). The Indian Grey Shrike.

Specimens collected: Kutch: KS91 ♀ 19-8-43 Chaduva (Bhuj Dist.); KS112 ♂ 24-8-43 Mandvi; KS375 ♂+ 15-3-44 Jakhau. Gujarat:

GS250 ♂, GS276 ♂ 17-11-45 Dabka (Baroda Dist.); GS452 ♀ 2-12-45 Golana (Cambay); GS509 ♀ 8-12-45 Pariej (Kaira Dist.); GS698 ♀, GS709 ♀ 24-12-45, GS741 ♀ 27-12-45 Patan (Mehsana Dist.); GS773 ♀ 31-12-45, GS831 ♂ 5-1-46 Radhanpur; GS893 ♀ 12-1-46 Deesa (Palanpur). Saurashtra: GS1024 ♀ 16-3-46 Dalkhania (Amreli Dist.).

Elsewhere noted: Kutch: Anjar; Ratnal; Rudra Mata; Rapar; Gedi; Desalpur; Khavda; Mata-no-Madh Lakhpat; Dholovira; Chhaparia; Pung Bet; Adesar. Gujarat: Palanpur; Kharaghoda; Ahmedabad environs.

Measurements:	W	B	Tar.	T
4 ♂♂	108–115	20–26	30–33	106–122
7 ♀♀	105–113	19–25	29–32	107–118

Ticehurst (*JBNHS*, 31 : 495) gives the tail length of *lahtora* as '117–129' which is surely too big? General moult was taking place in August.

Resident. Common. Met with singly or in pairs in stony, sparsely scrubbed semidesert country interspersed with cultivation. Breeding had commenced in March and April as evidenced by the enlarged gonads of the birds collected, and by the mutually attached and aggressively territorial behaviour of pairs. A nest with one fresh egg was taken on March 18. Butler (*SF*, iii : 462—1875) records it breeding in N. Gujarat in June and July when he found many nests.

The male at this season has a short pleasant tinkling call, rather like the Grey Tit's but more musical.

Lanius vittatus Valenciennes. The Baybacked Shrike.

Specimens collected: Kutch: KS127 ♂ juv. 30-8-43, KS185 ♀ 8-9-43, KS276 o? 26-9-43 Bhuj environs; KS149 ♂ 3-9-43 Nakhatrana; KS213 o? juv. 13-9-43 Khari Rohar; KS321 o? juv. 5-10-43 Nir (Kala Dongar, Pachham). Gujarat: GS27 ♀ 29-10-45 Ajwa (Baroda Dist.); GS137 o? 5-11-45 Bodeli; GS241 ♂ 15-11-45 Baroda City environs; GS381 ♀ 27-11-45 Cambay; GS483 ♂ 4-12-45 Golana (Cambay); GS592 ♂ juv. 16-12-45 Vaghjipur (Mehsana Dist.); GS742 ♀ 27-12-45 Patan (Mehsana Dist.); GS832 o? 5-1-46 Radhanpur; GS1074 ♀ 21-3-46 Kharaghoda. Saurashtra: B24 ♂ 17-10-43 Amreli.

Elsewhere noted: Kutch: Anjar; Ratnal; Rapar; Kandla; Mandvi; Dholovira. Gujarat: Deesa; Palanpur; Rajpipla; Viramgam.

Measurements:	W	B	Tar.	T
3 ♀♀ ad.	84–89	15–18	23–24	84–90

Rest of specimens not measured because of moult or doubtful sexing, or of being juveniles. Immature birds with rufous tails, are confusingly like adult *Lanius isabellinus* or *L. phoenicuroides*, but they usually show some grey on the upper tail coverts. Also the white wing 'mirror' is absent. Specimens No. KS321, a wobbly-flying juvenile just out of nest with rufous stub tail, is greyish sandy above, crossbarred on head and back with blackish fulvous.

Resident and fairly common, but subject to some local seasonal movement. Affects semidesert country as the Grey Shrike, but slightly better wooded—with babul groves, etc. From the evidence of juveniles, immature plumaged birds and moulting adults, the breeding season in the area would appear to be between July and September. The only direct indication was provided by a nest on October 5 (Kala Dongar, Kutch) with 3 stub-tailed wobbly-flying young just out of it.

Lanius collurio Linn. The Redbacked Shrike.

Specimens collected: Kutch: KS186 ♀ 8-9-43 Bhuj; KS221 o? imm., KS228 ♂ 15-9-43 Anjar; KS251 o? imm. 20-9-43 Rapar (Wagad Dist.).

Elsewhere noted: Kutch: Dholovira (Khadir Island). Not in Gujarat or Saurashtra.

Measurements:	W	B	Tar.	T
1 ♂ ad	92	16·5 (from feathers)	24	78
1 ♀ (1st year)	93	17	25	78
2 o ?	92–93	16–18	23–23·5	72·5–75

A not uncommon passage migrant (regular ?) to its winter quarters in Africa, Kutch (and perhaps N. Gujarat) lying on the extreme eastern fringe of its route south and west. A specimen was collected by Capt. Butler in the Deesa neighbourhood (*SF*, iii. 463—1875) who says it arrives in N. Gujarat about September 1. In 1943 my earliest date of meeting with it was September 15. Thereafter passage continued in fair strength (never abundant) till the first week of October. Only a single suspect was again seen on March 25, and it would appear that this species also follows a different route on return migration in spring.

In size and appearance this shrike is rather like *L. vittatus* from which, however, it may be differentiated in the field by the absence of the white wing 'mirrors' and by the large amount of white in the tail. The female is merely a duller edition of the male. Immature birds are almost impossible to tell with certainty from immature *L. phoenicuroides* in the field.

Lanius schach erythronotus (Vigors). The Rufousbacked Shrike.

Specimens collected: Kutch: KS395 ♂ 21-3-44 Bhuj environs; Gujarat: GS28 ♂ 29-10-45, GS55 ♂ GS56 o? 31-10-45 Ajwa (Baroda Dist.); GS251 ♀ 17-11-45 Dabka (Baroda Dist.); GS481 ♂, GS482 ♂ 4-12-45 Golana (Cambay); GS527 ♀ 9-12-45 Nadiad (Kaira Dist.); GS1048 ♀ 20-3-46 Kharaghoda; SD43 ♂ 27-2-48 Malegaon; SD172 ♀ 5-3-48 Pandwa (Surat Dangs).

Lanius schach caniceps Blyth. The Southern Greybacked Shrike.

Specimens collected: Kutch: KS14 ♂+, KS15 ♀+ 8-8-43 Rudra Mata; KS73 ♀+ 17-8-43 Chaduva (Bhuj Dist.). Gujarat: GS1049 ♂ 20-3-46 Kharaghoda.

Elsewhere noted (subspecies ?): Kutch: Chobari. (Bhachau Dist.) Gujarat: Patan (Mehsana Dist.); Rajpipla environs; Dediapada, Ghatoli (Rajpipla).

Measurements: (both races)	W	B	Tar.	T
2 ♂♂	90–96	19–20·5	23–28	113–115
3 ♀♀	87–90	18·5–20·5	27–29	99·5–109

In typical *erythronotus* the rufous of the rump extends on to the mantle; in typical *caniceps* it is more or less confined to the rump. But there is a regular cline and in a great many cases, especially in winter when both races are together, it is exceedingly difficult to decide where one character waxes and the other wanes and to assure oneself of the correct racial identity of individual specimens. In the Gujarat area *erythronotus* is only a winter visitor, whereas breeding birds (KS14, KS15, KS73), though clearly intermediate, are closer to and would readily pass for *caniceps*. It is this intermediate population which Koelz has recently named *kathiawarensis*. I am not convinced that any advantage is to be gained in naming this race, since it is clearly a stage in the colour cline.

Immature birds are easily confused in the field with various sub-adult plumages of *Lanius c. ph. enicuroides* and *L. isabellinus*, but *schach* has the upper parts greyer whereas in the others the upper parts are browner.

My earliest specimen of *erythronotus* is dated October 29; latest March 21.

L. s. caniceps breeds in Kutch principally in July and August. Nests with 4 newly hatched chicks in one case and 6 slightly incubated eggs in another were taken on August 8 and 17 respectively, and their owners collected. Capt. Butler (*SF*, iii: 463—1875) took several nests (of '*erythronotus*') about Deesa in N. Gujarat in June and July.

The preferential habitat of this shrike is a stage farther from semi-desert than that occupied by *L. vittatus*, namely fairly well wooded, well watered country. Thus while their ecological ranges may overlap along the seams, there is on the whole little competition for food among the 3 species *lahtora*, *vittatus*, and *schach*.

Lanius phoenicuroides ⋚ isabellinus

Specimens collected: Kutch: KS215 o? 14-9-43 Anjar; KS306 ♂ 2-10-43 Khavda (Pachham Island): KS335 ♂ 6-3-44 Bhuj environs Gujarat: GS310 ♂ 19-11-45 Dabka (Baroda Dist.); GS453 ♂ 2-12-45 Golana (Cambay); GS490 ♂ 6-12-45 Cambay; GS510 ♀ 8-12-45 Pariej (Kaira Dist.); GS539 ♀ 11-12-45 Nadiad (Kaira Dist.); GS566 ♂, GS567 ♀, GS568 ♂ 12-12-45 Saiat (Kaira Dist.); GS578 ♀ 15-12-45, GS593 ♀ 16-12-45 Vaghjipur (Mehsana Dist.); GS774 ♂, GS775 o? 31-12-45, GS830 ♂ 5-1-46 Radhanpur.

Elsewhere noted: Kutch: Khari Rohar; Pung Bet (Little Rann).

Measurements:	W	B	Tar.	T
8 ♂♂	91–97	17–20	25–27	80–85
5 ♀♀	90–94	17·5–20·5	24–25	78–83

Col. R. Meinertzhagen who kindly examined the above series, remarked as follows: 'None of your specimens are typical of either *phoenicuroides* or of *isabellinus*. They are all intermediates and agree with the form described as *Lanius collurio bogdanowi* (Bianchi) based on a bird from North Persia; it is not a good form but an intermediate or hybrid between *collurio* and *isabellinus* sometimes with a dash of *phoenicuroides*, and it is not constant within its reported breeding area. All your birds seem to be nearer *phoenicuroides* than to *isabellinus*. The form breeds in Tarbagatai.'

Winter visitor. Earliest date September 14; latest March 6. Solos frequent in semidesert biotope, within the facies of both *Lanius lahtora* and

L. vittatus. Easily confused in the field with immature *vittatus* and *collurio.* For points of diagnosis between immature plumages of *L. phoenicuroides* and *L. collurio* see Ticehurst 'Birds of Sind' (*Ibis* 1922, p. 609).

Lanius cristatus cristaus Linn. The Brown Shrike.

Specimens collected: Gujarat: GS1303 ♀ 20-4-46 Galkund, SD456 ♀ 25-3-48 Chikhli (Surat Dangs).

Elsewhere not noted in Gujarat, Saurashtra or Kutch.

Measurements:	W	B	Tar.	T
2 ♀♀	80–81	19–20	25–25·5	82–83

Both in general moult—body, wings, tail.

Winter visitor. Uncommon. Keeps singly to fairly thick secondary jungle.

Family SITTIDÆ: Nuthatches, Tree Creepers.

Salpornis spilonotus spilonotus (Franklin). The Spotted Grey Creeper.

Specimens collected: Gujarat: GS886 ♀ 11-1-46 Deesa (Palanpur), GS1149 ♀, GS1150 ♂+, GS1151 ♀+ 29-3-46, GS1162 ♂+ 30-3-46 Dediapada (Rajpipla).

Elsewhere not met with in Gujarat or Saurashtra. Absent in Kutch.

Measurements:	W	B	Tar.	T
2 ♂♂	90	25·5–26	16·5	52–53
3 ♀♀	87·5–89	24–28	16·5–17·5	49–51

Col. Meinertzhagen confirms that none of these specimens belong to the race *rajputanae* described by him from near the Sambhar Lake in the Jodhpur area, which is considerably paler and sandier below.

Deesa is on the fringe of Rajasthan *ca.* 250 miles SW. of Sambhar. In the specimen thence (GS886) the white of the throat extends to the upper breast, but there is no appreciable difference otherwise between it and birds from farther south, from the country between the Narbada and Tapti Rivers.

Not uncommon in the localities where met, but apt to be easily overlooked. General habits very like *Sitta* or *Certhia.* Singly or in pairs, affecting leafless pole forest of teak and other species. Clambering up tree trunks and boughs, as well as end twigs. The Pigmy Woodpecker (*Picoïdes nanus*), with which it is often coincident, is rather similar in appearance and actions but definitely prefers the thinner branches. When alighting on a tree-trunk after a flight the creeper 'tumbles' on to it with wings open, rather like a quail tumbling into grass, in contrast to a woodpecker which sweeps gracefully upwards with wings closed to flatten out against a bole. A feeble song of the volume and timbre of a sunbird's, of about 5 seconds' duration—*chichichiu-chi-chiu-chiu-chiu*—was heard.

Males on March 29 and 30 had somewhat enlarged testes, 3 × 2 and 4 × 2 mm. In a female on the former date the ovary was mature and the dilated oviduct indicated that she had laid.

Sitta frontalis frontalis Swainson. The Velvetfronted Nuthatch.

Specimens collected: Gujarat: GS1216 ♀ +, GS1217 ♂, GS1218 ♂ 8-4-46, GS1231 ♀ 9-4-46 Medha (Navsari Dist.); GS1293 ♂ 19-4-46, GS1302 ♂ + 20-4-46 Galkund; SD41 ♂ 26-2-48, SD196 ♂, SD197 ♀ 6-3-48 Pandwa (Surat Dangs).

Elsewhere not noted.

Measurements :	W	B	Tar.	T
6 ♂♂	72·5–77	15–16	15·5–16·5	37·5–40
3 ♀♀	70–71	14·5–16·5	15·5–16	35–41

These measurements agree both with Eastern Ghats birds diagnosed by Whistler ((*JBNHS*, 35 : 523) as *frontalis* and with birds from Sikkim separated as *corallina* on account of their smaller size! *S. f. frontalis* from Ceylon (the type locality) and S. India are larger and inseparable from each other. Already as far north as the Dangs intergradation in size seems to be complete, and the Gujarat series would readily pass for either race. Nevertheless it might be profitable to keep this series with *frontalis* if only for the sake of indicating continuity with the southern section of the Western Ghats. It is noteworthy that contrary to the normal condition (Bergmann's Rule), northern birds are in this case *smaller* than South Indian and Ceylonese examples.

Fairly common in moist deciduous forest. One example was observed clinging back downwards along the underside of a bare horizontal twig near the top of a high tree, head stiffly turned down at right angles, bill pointing to ground. It remained ' frozen ' thus for no apparent reason for over 3 minutes, and I had to make sure with binoculars again and again that it was in fact a bird before shooting at it!

Breeding was in progress during April. The female of April 8 had soft ovarian eggs, distended oviduct and incubation patch. A male on April 20 had enlarged testes.

Family PARIDAE

Subfamily PARINAE : Tits

Parus nuchalis Jerdon. The Whitewinged Black Tit.

Specimens collected: Kutch: KS47 ♂+, KS48 ♀+ 12-8-43 Bhuj environs; KS88 ♂+ 18-8-43, KS94 ♀, KS95 ♂ + 20-8-43 Chaduva, (Bhuj Dist.); KS278 ♂ 26-9-43, KS282 ♂ 27-9-43 Bhuj; KS380 ♀ juv. KS381 ♂ 17-3-44 Mata-no-Madh. Gujarat: GS878 ♂, GS879 ♀, GS880 ♂ 11-1-46 Deesa (Palanpur); GS936 o? 18-1-46 Gangasagar (Palanpur); GS951 ♂ 20-1-46 Balaram (Palanpur).

Not noted in Saurashtra. Observed on Taranga Hill (Mehsana Dist.) by Mr. R. M. Simmons in July 1931 and February 1932.

Measurements :	W	B	Tar.	T
9 ♂♂	65–71 (mostly above 68)	11–13	17–19	48–55
4 ♀♀	67	11–12	17·5–18·5	49–52

Complete post nuptial moult in September. All breeding birds have the white of the underparts conspicuously suffused with yellow, a point I have not seen in published descriptions.

Deciduous forest, Dediapada, Rajpipla (late March). Favourite haunt of the Spotted Tree Creeper (*Salpornis spilonotus*).

Photos *Author*

Whitewinged Black Tit (*Parus nuchalis*) at nest-hole in babul trunk. Chaduva. Kutch.

The white outer feathers of the tail and the white bars across the wings are conspicuous in flight and curiously reminiscent of a miniature Magpie Robin, and also of the cock Whitebellied Minivet (*P. erythropygius*).

Fairly common in Kutch but capriciously patchy. Sparse and sporadic in the Palanpur area of north Gujarat. Inhabits broken stony hummocky semidesert country where well covered with jungle of babul, kandi (*Prosopis spicigera*) and peeloo (*Salvadora persica* and *olecides*), and bushes of gugar (*Balsamodendron mukul*), gangi (*Grewia populifolia*) and similar species. In view of the habitat which is typical of it in this area, Jerdon's observation quoted by Stuart Baker (F.B.I. i: 79) that it keeps to the tops of heavily wooded hills in the Eastern Ghats seems incongruous.

As so little is known about the habits and nidification of this tit, it may be worthwhile to record the following. There is no difference in its general actions and behaviour from those of its better known cousin the Grey Tit. The birds keep in pairs or family parties of 4 or 5. The individuals maintain contact with one another by a clear musical whistling *tee-whi-whi* or *tee-whi-whi-whi* (or *see-pit-pit-pit-pit*) of the volume and quality of the Tailor Bird's calls. Besides these, the usual joyous harsh wheeching notes of the Grey Tit are uttered. Breeding was in full swing in July and August which are apparently the most favoured months in Kutch. Two nests were discovered at Chaduva (Bhuj Dist.) on August 20 and 21. Both were about 4 ft. up in holes in trunks of a babul and peeloo tree respectively. One, into which the owners were stuffing lining material—wool, cotton thread, etc.—was empty; the other contained chicks. Both parents were busy bringing food and removing packets of excreta. I was unable to ascertain the number of chicks. Strangely enough the egg still remains undescribed.

Before I first visited Bhuj in August 1943 my cousin Humayun Abdulali gave me the 'address' of one of these tits he had been shown about 6 years previously roosting at night in a particular hole in the cross-bar of a particular gate on the circular road round Bhujia Hill. He asked me half jokingly to try and call on his friend should I have the opportunity. On doing so at sunset on August 8 I was astonished to find the tit (same individual or successor ?) at home! When peeped at through a chink, the bird swayed its head and neck deliberately from side to side. In the dim light of the hole the white cheeks and streak down the neck heightened the snake-like effect. Three evenings later I visited the roost again at the same time, caught the bird in its hole and marked it with an aluminium ring. This ringed bird was still in occupation of its roost on April 4, 1944 (i.e. 8 months later). I have no knowledge whether that gate still exists, but it would be interesting to know how much longer this bird continued to sleep there and whether the hole has since been inherited by a successor—for the original occupant can no longer be alive.

Parus major stupae Koelz. The Indian Grey Tit.

Specimens collected: Saurashtra: GS975 ♂ 11-3-46 Ghatwad; GS1015 ♂ 16-3-46 Dalkhania. Gujarat: GS210 ♀, GS211 ♂ 10-11-45, GS225 o?, GS226 ♂ 11-11-45 Jambughoda; GS935 ♂ 18-1-46 Gangasagar (Palanpur); GS972 ♀, GS973 ♂, GS974 ♀ juv., GS1138 ♀, GS1139 ♂, GS1140 ♂ 29-3-46 Dediapada (Rajpipla); SD13 ♂ 24-2-48 SD21 ♂ 25-2-48, SD72

♂ 28-2-48, SD96 ♂ 29-2-48 Malegaon; SD162 ♀, SD163 ♀ 5-3-48 Pandwa; SD229 ♂, SD230 ♂ 10-3-48, SD285 ♀ 12-3-48 Laochali (SD = Surat Dangs).

Elsewhere noted: Gujarat: Hathidhara (Palanpur) Juna Rajpipla; Songadh, Medha (Navsari Dist.); Waghai, Galkund (Surat Dangs). Absent in Kutch.

Measurements:	W	B	Tar.	T
14 ♂♂	60–73	10–12	17–19	47–61
7 ♀♀	62–69	11–12	17·5–20	50·5–56

Resident. Rather sparsely and patchily distributed in light deciduous forest country. Inexplicably absent in many apparently suitable localities. The mutually excluding occurrence of this species and *P. nuchalis* is noteworthy. Freshly moulted in March and in full song, but no evidence of breeding. The song is a musical whistling *witwit-seesee, witwit-seesee, witwit* or *titiweesi, titiweesi, titiweesi, weesi* etc.

Parus xanthogenys aplonotus Blyth. The Central Indian Yellow-cheeked Tit.

Specimens collected: Gujarat: GS235 ♂ 5-11-45 Bodeli (Baroda Dist.); GS943 ♂, GS944 ♂ 19-1-46, GS962 ♀, GS963 ♂ Hathidhara (Palanpur); GS1100 ♂, GS1101 ♂ 25-3-46, GS1114 ♂, GS1115 ♀ 27-3-46 Juna Rajpipla; GS1141 ♀ 29-3-46 Dediapada (Rajpipla); SD22 ♂ 25-2-48, SD58 ♂, SD59 ♀ 27-2-48 Malegaon; SD176 ♀ 6-3-48, SD203 ♂, SD204 ♀ 7-3-48 Pandwa (SD = Surat Dangs).

Elsewhere not noted.

Measurements:	W	B	Tar.	T
10 ♂♂	70–74·5	11·5–12·5	18–20	52–57·5
6 ♀♀	66–69	10–13	17·5–19·5	49–51

In this race, as pointed out by Whistler (*JBNHS*, 41: 86), the males are all black crested and black banded ventrally; all females black crested with greenish grey ventral band.

Resident. Distributed rather sparsely and capriciously. On the whole keeping to more wooded parts than *P. major.* Not uncommon about Hathidhara at the foot of Mt. Abu (Palanpur, N. Gujarat), the Rajpipla area between the Narbada and Tapti Rivers, and in the Surat Dangs.

Family DICAEIDAE: Flowerpeckers

Dicaeum agile agile Tickell. The Thickbilled Flowerpecker.

Specimens collected: Gujarat: GS701 ♂ 24-12-45 Patan (Mehsana Dist.); GS1160 ♀ juv., GS1161 ♂+ 30-3-46 Dediapada (Rajpipla); SD258 ♀ 11-3-48 Laochali; SD401 ♂+ 20-3-48 Sarwar; SD459 ♀+ 25-3-48 Chikhli (SD = Surat Dangs).

No record from Saurashtra. Absent in Kutch.

Measurements:	W	B	Tar.	T
3 ♂♂	62–64	10–10·5	14–15	32–33·5
3 ♀♀	60	8·5–9·5	12·5–14	27–29·5

This flowerpecker seems to be somewhat less dependent upon loranthus than *Dicaeum erythrorhynchos*, and found in localities where the latter species and its favourite 'food' plant are absent. Its distribution is nevertheless curiously patchy. Apart from *Loranthus* berries it feeds largely on ripe figs of the peepal (*Ficus religiosa*). Breeding was in progress in March.

Dicaeum erythrorhynchos erythrorhynchos (Lath.) Tickell's Flowerpecker.

Specimens collected : Gujarat: GS1181 ♂ imm. 2-4-46 Dediapada (Rajpipla); GS1220 ♀ juv., GS1221 o? juv. 8-4-46 Songadh (Navsari Dist.); SD188 ♂+, SD189 ♀+ 6-3-48 Pandwa, SD344 ♂+ 17-3-48 Mheskatri, SD402 ♂ 20-3-48 Sarwar (SD = Surat Dangs).

Elsewhere noted : Gujarat: Pavagadh (Panchmahals Dist.). Not observed in Kutch.

Measurements:	W	B	Tar.	T
4 ♂♂	48–50	10·5–13	11–13	22–23
1 ♀	47	11·5	12	24

Apart from the difference in colour of bill (*pinkish* in this species), *Dicaeum concolor*, which may possibly occur in the Surat Dangs-Songadh-Rajpipla area, can be distinguished by its sullied white lores and sides of forehead continued in a narrow supercilium to behind the eyes.

As elsewhere, inseparable from clumps of the *Loranthus* plant parasite infesting mango and other trees. Wherever *Loranthus* was absent, so was this flowerpecker. Breeding was in progress during March and April.

Family NECTARINIIDAE : Sunbirds

Nectarinia zeylonica (Linn.). The Purplerumped Sunbird.

Of this I have only a single unconfirmed sight record from Pavagadh (Panchmahals Dist.) 30-10-44. It seems curious that the species should be so rare in Gujarat.

Nectarinia asiatica asiatica (Latham). The Purple Sunbird.

Specimens collected : Kutch: KS78 ♂ + 17-8-43 Chaduva (Bhuj Dist.); KS110 ♂ imm., KS111 ♀ 24-8-43 Mandvi; KS243 ♂ 18-9-43 Bhachau. Gujarat: GS233 [♂] 11-11-45 Jambughoda; GS372 ♂ 22-11-45 Dabka (Baroda Dist.); GS783 ♂ 31-12-45, GS797 ♂ 1-1-46, GS837 ♂ 5-1-46 Radhanpur; GS852 ♀ 9-1-46 Deesa (Palanpur); SD73 ♂+ 28-2-48 Malegaon; SD299 ♀ 14-3-48 Mahal; SD363 ♂+ 18-3-48 Mheskatri; SD427 ♂+, SD428 ♀ 22-3-48 Pimpri (SD series = Surat Dangs).

Measurements:	W	B	Tar.	T
10 ♂♂	55–59	18–23	14–16·5	31–37·5
4 ♀♀	51–54	18–20	14–15	28·5–31

These females, and ♂♂ in eclipse, are somewhat greener above than those from the Eastern Ghats, but the birds all seem to be of the typical race. The Great Rann of Kutch is evidently the dividing barrier between this race and *brevirostris* of Sind, etc. What the precise criteria are for the diagnosis of *brevirostris* is, however, uncertain. Baker (Fauna iii : 399) says *smaller bill* (as the name indicates) and measures it 13–15 mm. Ticehurst (Birds of Sind, *Ibis* 1923 : 24) gives the bill as '14–16·5, mostly about 15 mm.' Whistler measures the bill of a male collected by the Bahawalpur Survey and assigned by himself as *brevirostris* (*JBNHS*, 42 : 732) 19·5 mm., therefore very near the maximum for the typical race. [Bill of 9 ♂♂ from the Eastern Ghats (*asiatica*) were measured by him 20–21 mm. (*JBNHS*, 37: 283)]. The Fauna (iii : 396) gives 'culmen about 16–19 mm.' for *asiatica*. Specimens from Jodhpur are identified by Whistler as *C. a. asiatica* (*JBNHS*, 40 : 225)

Two breeding males from the Surat Dangs have well-defined unbroken maroon pectoral bands as in *lotenia*, but narrower. The glistening metallic black abdomen of *asiatica* as against dull sooty black in *lotenia* is perhaps its most reliable diagnostic character. Also bill in *lotenia* is longer and much more bowed, reminiscent of *Xiphirhynchus*.

A fairly common resident usually seen probing into blossoms for nectar. *Capparis*, *Calotropis*, *Prosopis*, *Erythrina*, *Bombax*, *Loranthus*, *Butea* and *Woodfordia* are some of the most regularly patronized species. There is apparently no definite breeding season. Males in breeding plumage and birds in all stages of moult are commonly seen side by side with others in eclipse plumage (with yellow underparts and a black ventral band) at all times of the year. The gonads also show vastly differential development seasonally, being mature in some individuals and with no sign of development in others. Nests with eggs or young were found in August as well as March, though perhaps the greater part of the breeding takes place around the latter month.

Aethopyga siparaja vigorsi (Sykes). Vigor's Yellowbacked Sunbird.

Specimens collected: Gujarat: GS1091 ♂ 25-3-46; GS1123 ♂, GS1124♂. GS1125 ♀ 27-3-46 Juna Rajpipla; GS1229 ♂ 9-4-46 Songadh (Navsari Dist.); GS1246 ♂, GS1247 ♂ 12-4-46 Waghai (Surat Dangs); SD4 ♂ 23-2-48, SD14 ♂ 24-2-48, SD32 ♂, SD33 ♂ 25-2-48 Malegaon; SD95 ♀ 29-2-48 Malegaon; SD364 ♀ 18-3-48 Mheskatri; SD396 ♀? 20-3-48 Sarwar; SD426♀ 22-3-48 Pimpri; SD438 ♂, SD439 ♀ 2-43-48 Waghai (SD = Surat Dangs).

Measurements :	W	B	Tar.	T
11 ♂♂	61–65	23–27·5	15–16·5	50–58
3 ♀♀	55–57	21–24	15·5	38–38·5
3 ♀♀ (red breasted)	54–56	22–22·5	15–15·5	35·5–37·5

The Juna Rajpipla specimens extend the range of this species northward to the Narbada River. It is common in the Surat Dangs.

Two females (sex confirmed personally) have the chin, throat and breast a dull orange-scarlet with greyish brown bases to the feathers showing through. This is also the case with a third female sexed by Mr. Gabriel marked as doubtful. Some of the breast feathers in these specimens are actually olive-brown tipped with orange scarlet; rest of underparts yellowish olive-brown. This red-throated phase of the female has not been described in literature.

In the three other females the chin, throat and breast are greyish brown with a faint pinkish tinge. The crown and forehead are rufous-brown, contrasting with the olive-greenish brown back.

All the specimens were in varying stages of general moult (February/March) and showed no departure from the non-breeding condition in their gonads.

Family ZOSTEROPIDAE : White-eyes

Zosterops palpebrosa occidentis Ticehurst. The White-eye.

Specimens collected: Gujarat: GS85 ♂ 1-11-45 Ajwa (Baroda Dist.); GS252♀, GS253 ♀ 17-11-45 Dabka (Baroda Dist.); GS584 ♂, GS585 ♂ 15-12-45, GS634 o? 18-12-45 Vaghjipur (Mehsana Dist.), GS896 ♀, GS897 ♂ 12-1-46 Deesa (Palanpur); GS1146♂ 29-3-46 Dediapada (Rajpipla); GS1278 ♂, GS1279 ♀+ 16-4-46 Mahal (Surat Dangs); SD60 ♂ 27-2-48, SD86 ♂, SD87 ♂ Malegaon, SD328 ♂ 16-3-48 (Mheskatri, SD414 ♂ 22-3-48 Pimpri, SD440 ♂ 24-3-48 Waghai (SD=Surat Dangs) Saurashtra: GS1018 ♂, GS1019 ♀ 16-3-46 Dalkhania (Amreli Dist.).

Not recorded in Kutch.

Measurements :	W	B	Tar.	T
13 ♂♂	53–57	11–13	15–16·5	36–40·5
3 ♀♀	54–55	11–12	15–16	37–39

I attribute the above specimens to this race following Ticehurst's opinion that *occidentis* occupies all Bombay Preaidency south to N. Kanara and Mysore (*JBNHS*, *32* : 354). Personally it appears to me that in colour, both above and below, many of the specimens would pass completely for the race *Z. p. sálimalii* though series for series the bill of that race is perhaps smaller and finer, as described. Measurements alone, however, are insufficient to show this character clearly. 16 ♂ ♀ of *sálimalii* from the Eastern Ghats have bills 11–12·5 (*JBNHS*, 37: 281).

Common, in flocks, frequently of over 50 individuals. Feeds largely on flower nectar, some of the most favourite and regularly visited blossoms being those of *Alangium lamarckii Woodfordia fruticosa*, *Eugenia jambolana* and species of *Loranthus*. Birds in late February and through March were in heavy pre-nuptial moult. The first indication of gonadal development was observed in the specimen of 16 April.

Family FRINGILLIDAE : Buntings, Finches

Emberiza buchanani Blyth. The Greynecked Bunting.

Specimens collected: Kutch: KS181 ♀ 7-9-43, KS183 ♀ 8-9-43, KS269 ♀ 25-9-43 Bhuj; KS382 ♂ 17-3-44 Mata-no-Madh. Gujarat: GS110 ♀ 2-11-45 Ajwa (Baroda Dist.); GS198 o? 9-11-45 Bodeli (Baroda Dist.); GS717 ♂ 25-12-45 Patan (Mehsana Dist.); GS844 ♂, GS845 ♂ 9-1-46 Deesa (Palanpur); Saurashtra: GS969 ♂ 11-3-46 Ghatwad (Kodinar) B15 ♂, B16 ♂ 14-10-43 Dwarka (Okhamandal; B44 ♂ 20-10-43 Dhari (Amereli Dist.).

Measurements :	W	B	Tar.	T
8 ♂♂	86·5–93·5	13–15	19–22	69–77
3 ♀	82–88	11·5–14	18·5–20	68·5–70

A not uncommon winter visitor. Earliest date August 30; latest April 21. Keeps to stony, sparsely scrubbed and Euphorbia-covered hillsides and broken ground, in loose parties. Noted as abundant in Kutch during September when great numbers were presumably coming through on southward passage. Utters a subdued *click*, *click*,

Emberiza striolata striolata (Licht.). The Striolated Bunting.

Specimens collected: Kutch: KS16 ♂+ 9-8-43, KS39 ♂+ 11-8-43, KS146 ♂+ 1-9-43, KS427 ♀ 1-4-44 Bhuj; Gujarat: GS846 o?, GS847 ♂ 9-1-46, GS870 o? 10-1-46 Deesa (Palanpur).

Elsewhere noted: Kutch: Nakhatrana; Bhachau; Rapar; Nir; Mata-no-Madh; Khadir Island (Great Rann); Bela Island; Kala Dongar. Gujarat: Patan (Mehsana Dist.), Saurashtra: Dwarka; Ghatwad (Kodinar).

Measurements:	W	B	Tar.	T
4 ♂♂	79–85	11–13	16–16·5	55–63
1 ♀	75	11	15	56

Resident. Common and locally abundant. Affects stony, sparsely scrubbed hillsides and broken country, hopping about on the ground stiffly like a sparrow, not running like pipit. Fluctuation of numbers in a given locality suggests considerable local movement. Males were in full song from about mid-March. Breeding activity first in evidence in April (enlarged gonads); actual nests with eggs (usually 3) seen as late as September. The song is a lively *which-which-wheech-whichy-which* (first 2 syllables short, and accent on the final *which*). It is uttered from a stone, bush-top or ruined building in the vicinity of the nest.

Large numbers of Striolated Buntings gathered to drink at a waterhole in arid stony country bordering the Great Rann of Kutch regularly between 8 and 11 a.m. in March, in company with *Emberiza buchanani*. Each bird took 10 to 15 or more sips, often occupying over a minute.

Emberiza melanocephala Scopoli. The Blackheaded Bunting.

Specimens collected: Kutch: KS396 ♂, KS397 ♂, KS398♂, KS399 ♂ 2-3-44 Chobari (Bhachau Dist.); Gujarat: GS64 ♂ 31-10-45 Ajwa (Baroda Dist.); GS345 o?, GS346 o? 21-11-45 Dabka (Baroda Dist.); GS1075 ♂ 21-3-46 Kharaghoda.

Measurements:	W	B	Tar.	T
6 ♂♂	92–99	15–17	20–23·5	68–78
2 o ? [♀]	86–89	16–16·5	21·5–22	68–68·5

Females of this species are difficult to distinguish from female Redheaded Bunting (*Emberiza brunniceps*) unless in perfect adult plumage.

A fairly common winter visitor. Earliest date 31 October; latest 1 April. All specimens after 20 March were excessively fat, indicating that they were ready for emigration. A male on 23 March, had in addition, developing testes (3 × 2mm.).

Large flocks in cultivation. Roosting in enormous swarms, in association with House and Yellowthroated Sparrows in the thorn-scrub covered ravines along the banks of the Mahi River near its mouth at Dabka (Baroda Dist.).

Emberiza brunniceps Brandt. The Redheaded Bunting.

Specimens collected: Saurashtra: B45 ♂ 20-10-43 Dhari (Amreli Dist.); Gujarat: GS197 ♂ 9-11-45 Bodeli (Baroda Dist.); GS574 ♂ 12-12-45 Saiat (Kaira Dist.).

Measurements :	W	B	Tar.	T
2 ♂♂	85–90	16–17	19–22	70 (1)

About equally common in winter (more so in Gujarat and Saurashtra than in Kutch) with the Blackheaded Bunting. Usually seen in flocks mixed with *melanocephala* and sometimes with *E. buchanani* in stony bajri fields (*Sorghum*). The specimens of 20 October and 9 November were in heavy general moult.

Melophus lathami subcristata (Sykes). The Crested Bunting.

Specimens collected: Gujarat: GS270 ♀ 17-11-45 Dabka (Baroda Dist.); GS1157 ♂, GS1158 ♂ 30-3-46, GS1183 ♂ 2-4-46 Dediapada (Rajpipla).

Not observed in Kutch or Saurashtra.

Measurements :	W	B	Tar.	T
3 ♂♂	79	13–15	19·5–21	61–66
1 ♀	77	15	—	63

Local and uncommon in Gujarat. Affects stony grass country, particularly burnt patches, in or on the edge of deciduous forest. Pairs, or loose parties of 4 or 5. Song sporadic in April: *which-which-whi-whē-which* (first 2 syllables in undertone, and the last but one *whee* drawn out and accentuated).

Subfamily FRINGILLINAE

Erythrina erythrina roseatus (Blyth). The Indian Rosefinch.

Specimens collected: Gujarat: GS203 o? 9-11-45 Bodeli (Baroda Dist.); GS597 ♀ 16-12-45, GS632 ♂, GS633 ♀ 18-12-45, GS662 ♀, GS663 ♂ 20-12-45 Vaghjipur (Mehsana Dist.); GS950 ♂ 20-1-46 Balaram (Palanpur); GS1105 ♂ 25-3-46 Juna Rajpipla; GS1176 ♂ 31-3-46 Dediapada (Rajpipla); SD42 ♂ 26-2-48 Galkund, SD429 ♀ 22-3-48 Pimpri, SD445 ♂ 24-3-48 Waghai (SD = Surat Dangs). Observed also at several places in Saurashtra and Kutch.

Measurements :	W	B	Tar.	T
7 ♂♂	85–90	12·5–14	19–19·5	56–61
4 ♀♀	80–85	13–13·5	19–19·5	54–58

Two males (Nos. GS632 and GS950), in fresh plumage, match well with No. 227 of the Central India Survey which is one of the 4 examples in fresh plumage assigned by Whistler (*Ibis*, 1939 p. 159) to the typical race *erythrina*. These two specimens may well pass for the typical form, but it seems impossible to me to be definite on the point.

Winter visitor. Not uncommon. The latest date recorded by the Surveys is April 18 (Anjar, Kutch). Met with in forest, scrub jungle as well as cultivation—in the last often associated with flocks of Blackheaded Buntings (*Emberiza melanocephala*). When the birds first arrive in their winter quarters, the flocks consist mostly of female-plumaged brown birds. With abrasion of the feathers more and more pink males come into prominence as the season advances, and their rosy pink colour is brightest before they leave for their breeding grounds.

Family Ploceidae: Weaver Finches.

Petronia xanthocollis xanthocollis (Burton). The Yellowthroated Sparrow.

Specimens collected: Kutch: KS159 ♂+ 4-9-43 Dhinodhar Hill, Nakhatrana; KS1 ♂ 7-8-43, KS425 ♀+ 31-3-44 Bhuj. Gujarat: GS139 ♂, GS140 o? 6-11-45, GS194 ♂ 8-11-45 Bodeli (Baroda Dist.); GS325 ♂ 20-11-45, GS349 ♀ 21-11-45 Dabka (Baroda Dist.); GS680 ♀ 21-12-45 Vaghjipur (Mehsana Dist.); GS728 ♀ 26-12-45 Patan (Mehsana); GS819 ♂ 3-1-46 Radhanpur; GS899 ♂ 12-1-46 Deesa (Palanpur); GS1116 ♂+27-3-46 Juna Rajpipla; GS1235 ♂+ 9-4-46 Songadh (Navsari Dist.); SD15 ♂+ 24-2-48, SD75 ♂+ 28-2-48 Malegaon, SD178 ♀ 6-3-48 Pandwa, SD269 ♂+, SD270 ♂+ 12-3-48 Laochali, SD303 ♀+ 14-3-48 Mahal, SD367 ♂+, SD368 ♀ + 18-3-48 Mheskatri, SD395 ♂+ 20-3-48 Sarwar; SD413 ♂+ 22-3-48 Pimpri (SD = Surat Dangs).

Measurements:	W	B	Tar.	T
15 ♂♂	81–88	13–16	16–18·5	47–57
7 ♀	76–85	13·5–16	16·5–18	45–55

Birds from about Nadiad north, i.e. Patan & Vaghjipur (Mehsana), Radhanpur, Deesa (Palanpur), and also from Kutch, are intermediate between *xanthocollis* and *transfuga* and match specimens from the Jodhpur Survey (*JBNHS*, 40: 222).

A common and abundant species everywhere, but subject to marked seasonal local movement. Affects dry deciduous teak, babul, kandi and catechu forest in preference to bamboo jungle. In winter very large flocks are seen, reminiscent of flocks of buntings or Short-toed Larks. Enormous assemblages, mixed with thousands of House Sparrows and Blackheaded Buntings, were observed in November/December roosting nightly amongst the thickets of *Zizyphus*, *Capparis* and *Salvadora oleoides* in the out-scoured ravines on the banks of the Mahi River at Dabka (Baroda Dist.), and elsewhere.

Breeding was in progress during March/April. Holes and cracks in tree-trunks and in snags of branches are ultilized. In the breeding season the male's bill becomes black. In non-breeding males the upper mandible is horny brown; lower mandible pinkish brown.

In semidesert areas nectar of the flowers of *Capparis aphylla* is a favourite food. In quest of this, the forehead feathers become golden with adhering pollen and give to the birds an unusually distinguished and intriguing appearance in the distance!

Passer domesticus indicus (Jardine & Selby). The House Sparrow.

Specimens collected: Kutch: KS96 ♂+, KS97 ♀+ 20-8-43 Chaduva (Bhuj Dist.) Gujarat: GS320 ♂, GS321 ♂, GS322 ♂, GS323 ♀, GS324 ♀ 20-11-45 Dabka (Baroda Dist.); GS525 ♂, GS526 ♂ 9-12-45 Nadiad town environs (Kaira Dist.).

Measurements:	W	B	Tar.	T
6 ♂♂	(73) 78–82·5	13·5–14	19–20	52–61
3 ♀♀	75–80	14	20	52–56·5

It will be seen that the above wing measurements are larger than given by Mr. Whistler for NW. Indian birds ('12 ♂♂ 75-79 mm.') in the Hyderabad Survey report (*JBNHS*, 36: 902). They are also larger than 8 Punjab males measured by him as 72·5–78 in the Travancore Survey report (*JBNHS*, 38 : 511). This discrepancy may be largely due to the fact that all my measurements were taken *in the flesh.* In wing length this usually means 1–3 mm. more in birds up to about a thrush in size. I cannot see any difference in colour between northern birds and these from Gujarat.

Ubiquitous. Collects in enormous flocks during winter, feeding in scrub jungle and on the countryside far away from human habitations. Vast assemblages collected to roost amongst dense thickets of *Zizyphus oenoplia*, etc. in outscoured ravines on the banks of Mahi River at Dabka (Baroda). The birds arrived in a succession of flocks from all directions a little before sunset. When shooting down into the thickets, or flying out on alarm the whir of their thousand wings was like surf breaking in the distance.

Breeding was at its height in Kutch during July/August and September. In the town of Bhuj the young were fed very largely on a green defoliating caterpillar which was swarming on googar (*Balsamodendron mukul*), and other bushes, denuding them completely of the newly sprouting leaves.

Ploceus philippinus philippinus (Linn.). The Common Weaver Bird or Baya.

Specimens collected: Kutch : KS77 ♂+ 17-8-43 Chaduva (Bhuj Dist.); KS406 ♂ 24-3-44 Chobari (Bhachau Dist.); Gujarat : GS65 ♂, GS66 ♀, GS67 ♂, GS68 ♂, GS69 ♀ 31-10-45 Ajwa (Baroda Dist.); GS386 ♀ 27-11-45 Cambay town environs; GS925 ♀, GS926 ♂ 16-1-46 Palanpur.

Measurements:	W	B	Tar.	T
3 ♂♂	70–73	16–18	18–21	45–49
2 ♀♀	68–69·5	17	20	46–47

In heavy post-nuptial moult in late October; fresh winter plumage late November. In suitable localities everywhere, moving about locally with seasonal conditions. Breeding was in full swing during August (Kutch). A favourite site for the nest colonies, seldom of more than 15 to 20 nests together, was trees like *Prosopis spicigera* and thorny bushes growing from the side of, or overhanging, a well in the vicinity of cultivators' homesteads and fields. The observed proportion of males to females in the colonies was, as elsewhere, approximately 1 : 3. The birds are very partial to the nectar of flowers of *Capparis aphylla* in season with whose pollen their forehead feathers were usually thickly coated.

Dr. Koelz has recently described a new race from Saurashtra naming it *P. p. sardarpateli.*

Ploceus benghalensis (Linn.). The Blackthroated Weaver Bird.

Specimens collected: Gujarat: GS52 ♂, GS53 ♂, GS54 ♀ 31-10-45 Ajwa (Baroda Dist.); GS555 ♀, GS556 ♀, GS557 ♀, GS558 ♀, GS559 ♀ 12-12-45 Saiat (Kaira Dist.).

Measurements:	W	B	Tar.	T
5 ♀♀	65–71·5	16–16·5	21–21·5	38–45

All the specimens of 31 October are in heavy post-nuptial moult; the December specimens in fresh winter plumage.

Not common; locally and patchily distributed. Usually affects reeds, etc., on the edge of marshes and jheels. All the 5 December birds, killed in one shot from a large flock, proved to be females, suggesting that the sexes may segregate at this season (soon after breeding). Further data on this point are desirable.

Estrilda amandava amandava (Linn.). The Red Munia.

Specimens not collected. Observed at Ajwa (Baroda Dist.) and Dakor (Kaira Dist.) in reedy, swampy environs of tanks. On October 29 a male was carrying a fine flowering grass stem to a half-built nest about 2 ft. up in a tussock of coarse grass on the swampy margin of Ajwa Reservoir. Mr. R. M. Simmons (*in epist.*) observed a flock of 20–30 amongst reeds in Hathmatti River at Himmatnagar (Sabarkantha) in February 1932.

Estrilda formosa (Latham). The Green Munia.

Specimens collected: Gujarat: GS931 ♀, GS932 ♂ 18-1-46 Gangasagar (Palanpur); GS1087 ♂ 24-3-46 Navagam (Rajpipla); GS1164 ♂, GS1165 ♀, GS1166 ♂, GS1167 ♀, GS1168 ♀, GS1169 ♂ 30-3-46 Dediapada (Rajpipla).

Not recorded in Saurashtra. Absent in Kutch.

Locally and capriciously distributed. Avoids semidesert and arid country, but also absent over large seemingly suitable areas. The specimens provided no indication as regards the breeding season. All those taken in March were in heavy body moult.

Keeps in flocks of 20 or so in lantana scrub country. Utters feeble cheeps like Red Munia.

Lonchura striata striata (Linn.). The Whitebacked Munia.

Specimens collected: Gujarat: GS1282 ♀, GS1283 ♂, GS1284 ♂ GS1285 ♀, GS1286 ♂ 17-4-46 Mahal (Surat Dangs).

Measurements:	W	B	Tar.	T
3 ♂♂	52–53	13–14	14–14·5	35–36
2 ♀♀	53–54	13–13·5	14–14·5	35–37·5

All the above undergoing complete moult, agreeing with 'March to July' as given by Whistler for the Eastern Ghats (*JBNHS*, 36 : 834).

The species was not recorded in the rest of Gujarat, or in Kutch or Saurashtra. It affected open scrub country near cultivation.

Lonchura malabarica (Linn.). The Whitethroated Munia.

Specimens collected: Kutch: KS85 ♀+, KS86 ♂+ 18-8-43 Chaduva, (Bhuj Dist.). Gujarat: GS156 ♂+ 7-11-45 Bodeli ((Baroda Dist.); GS473 ♂, GS474 ♂ 3-12-45 Golana (Cambay); GS664 ♀+ 20-12-45 Vaghjipur (Mehsana Dist.).

Measurements:	W	B	Tar.	T
4 ♂♂	55–58·5	9·5–11	13·5–15	39–48
2 ♀♀	55–56	11–11·5	13·5–15	42–48

Fairly common and general. Nesting season apparently not well defined, and straggles over most months of the year. It was in full swing in Kutch during August and September. The nest material in this area consists chiefly of fine flowering grass. In one case a large amount of bits of old newspaper was used in the exterior of the globe. As elsewhere, disused Baya nests are freely appropriated. One pair was observed entering and leaving the pile of sticks forming the nest of a King Vulture (*Sareogyps calvus*) on which the owner was sitting on its egg !

Lonchura punctulata lineoventer (Hodgson). The Spotted Munia.

Specimens collected : Gujarat: GS81 ♀+, GS 82 ♂+ 1-11-45 Ajwa (Baroda Dist.); GS1177 ♀, GS1178 ♂, GS1179 ♀ 31-3-46 Dediapada (Rajpipla).

Measurements :	W	B	Tar.	T
2 ♂♂	54–58	12·5–13	15–16	32–36·5
3 ♀♀	55–57	12·5–13	15–15·5	33·5–38

Fairly common in the better wooded parts of the area. Not observed in Kutch or Saurashtra, though it doubtless occurs in the latter in suitable localities. The specimens of September 1 were a breeding pair. In March the flocks consisted largely of birds in the plain brown non-breeding plumage, and contained many young of the year.

Family STURNIDAE : Mynas

Sturnus roseus (Linn.). The Rosy Pastar.

Specimens collected : Kutch: KS24 ♂, KS25 ♂ juv. 9-8-43 Bhuj; KS400 ♀, KS401 ♂+ 23-3-44 Chobari (Bhachau Dist.). Gujarat: GS73 ♂, GS74 ♀, GS75 ♀, GS76 ♂ 1-11-45 Ajwa (Baroda Dist.) ; GS671 ♂ 20-12-45 Vaghjipnr (Mehsana) ; GS778 ♂, GS779 ♀, GS780 ♂ 31-12-45 Radhanpur ; GS1052 ♂, GS1053 ♀, GS1054 ♂ 20-3-46 Kharaghoda.

Measurements :	W	B	Tar.	T
7 ♂♂ ad.	132–135	24–25	30·5–32	67–73
3 ♀♀ ad.	125–136	22·5–23·5	27·5–33	65–72

Winter visitor. Common and abundant. Earliest date August 5. The specimen of March 23 (KS401) was very fat preparatory to emigration and also showed some gonadal development (testes 5 × 3 mm.) Between March 25 and 28 (1944) on Khadir and Bela Islands on the southern edge of the Great Rann of Kutch, strong northward migration of pastors was observed in progress. Parties, and flocks of 40 to 50 birds in an intermittent stream were flying in a N. and NW. direction (towards Sind) between 8.30 and at least 10.30 a.m. They kept about 50 feet above the ground and flew directly and purposefully. Some of the birds occasionally alighted on the bushtops for a few moments without attempting to feed, and presently took off again. On reaching the edge of the actual Rann each flock immediately rose higher. Some disorder and hesitancy was noticeable before the flocks re-formed and resumed their flight across the barren waterless expanse which is about 35 miles wide at this point.

Sturnus malabaricus [**blythii** (Jerdon)]. The Whitehead Myna.

Specimen collected : Gujarat: GS31 ♂ 29-10-45 Ajwa (Baroda Dist.).

Measurements :	W	B	Tar.	T
1♂	104	23	25	62

This specimen has the whole head, sides of face, chin and throat silvery greyish white. The upper breast is ferruginous like the rest of the underparts, much streaked with greyish white.

Sturnus pagodarum (Gmel.). The Blackheaded or Brahminy Myna.

Specimens collected: Gujarat: GS86 ♀ 1-11-45, GS101 ♂, GS102 ♂ 2-11-45 Ajwa (Baroda Dist.); GS546 ♀ 11-12-45 Nadiad (Kaira Dist.); GS1142 ♀, GS1143 ♂ 29-3-46 Dediapada (Rajpipla).

Measurements :	W	B	Tar.	T
3 ♂♂	105–109	20·5–24	29–30	60–69
3 ♀♀	101–109	19·5–21	28–28·5	61–68

Uncommon, capricious and local in Kutch; fairly common in Saurashtra and Gujarat. Breeding in Kutch August/September. According to Lester June/July.

Sturnus vulgaris poltaratzskii Finsch. Finsch's Starling.

Specimens collected: Gujarat: GS312 ♀ 19-11-45 Dabka (Baroda Dist.); GS564 ♀, GS565 o? 12-12-45 Saiat (Kaira Dist.).

Elsewhere not noted.

Measurements :	W	B	Tar.	T
2 ♀♀	130–133	29–32	30	65–68·5
1 [♀]	130	30	30	65

Evidently an uncommon straggler in winter; also recorded as such from Kutch. Mr. R. M. Simmons (*in epist.*) saw it often round jheels in winter, e.g., at Tarapur (near Cambay) and Bareja. Dr. H. C. Aldrich met with large flocks at Pariej (Kaira Dist.) in September 1945.

Acridotheres tristis tristis (Linn.). The Common Myna.

Specimens collected: Kutch: KS407 ♂+ 24-3-44 Chobari (Bhachau Dist.).; Gujarat: GS96 ♂, GS97 ♀ 2-11-45 Ajwa (Baroda Dist.); GS224 ♀ 11-11-45 Bodeli (Baroda Dist.); GS1076 ♀ 21-3-46 Kharaghoda; SD82 ♂ 29-2-48 Malegaon (Surat Dangs).

Measurements :	W	B	Tar.	T
3 ♂♂	147–151	25–28	40–42	85–93
3 ♀♀	139–143·5	25–27·5	40·5–41	79–84

Testes of a male in Kutch on March 24 had enlarged to 4×3 mm. The normal breeding season in Gujarat is June to August. Post-nuptial moult October/November.

An ubiquitous species, particularly abundant near human habitations.

Acridotheres ginginianus (Lath.). The Bank Myna.

Specimens collected: Gujarat: GS98 ♀. GS99 ♂, GS100 ♂ 2-11-45 Ajwa (Baroda Dist.).

Measurements:	W	B	Tar.	T
2 ♂♂	120–121	25	37	65–65·5
1 ♀	114	24·5	36	60

Fairly common in Kutch, but curiously local and patchy. Commonly in attendance on grazing cattle. Abundant in Central Gujarat (Viramgam, Ahmedabad, Surat, Cambay, Broach, Baroda, etc.) where large numbers are always present on railway station platforms, running about fearlessly in amongst the passengers' feet and baggage, and picking up crumbs strewn by the charitably disposed. Frequently hopping on to vendors' handcarts and filching *seo* in spite of the vehement protestations of the owners. At certain railway stations this species has more or less completely displaced the Common Myna. But even in Gujarat it is inexplicably scarce, or absent, in places within a few miles of where it may be abundant even to the virtual exclusion of *tristis*.

Breeding was in progress in Kutch during August and September. Favourite sites here are holes in the earthen sides of kutcha wells, shared out concurrently with House Sparrows and Blue Rock Pigeons. The nest-holes are often deep down the narrow shafts of these wells necessitating almost vertical ascent to reach the top, and one wonders how the inexperienced fledglings manage to accomplish this feat without heavier casualties than there are.

In many Gujarat towns the birds nest freely in holes in the walls of buildings even in the midst of the noisiest bazars.

Family ORIOLIDAE : Orioles

Oriolus oriolus kundoo Sykes. The Indian Golden Oriole.

Specimens collected: Kutch: KS217 ♀, KS218 ♀, 14-9-43 Tuna (Anjar Dist.). Gujarat: GS29 ♂ 29-10-45 Ajwa (Baroda Dist.); GS160 ♂ 7-11-45 Bodeli (Baroda Dist.); GS174 ♂ 9-11-45; GS335 ♂ 20-11-45 Dabka (Baroda Dist.); GS711 ♂ 25-12-45 Patan (Mehsana Dist.); GS839 ♂ 6-1-46 Radhanpur; SD324 ♂ 16-3-48 Mheskatri (Surat Dangs).

Noted in Saurashtra in Amreli town and Dhari.

Measurements :	W	B	Tar.	T
7 ♂♂	139–147	29·5–33	22–24 (26·5)	86–93
2 ♀♀	138–143	31–33	23·5–24	89–91

Uncommon in Kutch; sporadic solos frequent elsewhere. Apparently only a winter visitor. The earliest specimens (of September 13 and 14) were fat. The first and last dates recorded by the Surveys are August 24 and April 19.

Oriolus xanthornus maderaspatanus Franklin (Linn.). The Black-headed Oriole.

Specimens collected: Gujarat: GS1092 ♀ 25-3-46 Juna Rajpipla; GS1180 ♂ 2-4-46 Dediapada; SD125 ♂, SD126 ♂ 2-3-48 Galkund (Surat Dangs); SD244 ♀, 10-3-48, SD264 ♂ 11-3-48 Laochali; SD315 ♀ 14-3-48 Mahal; SD325 ♀ 16-3-48, SD357 ♂ 18-3-48 Mheskatri.

Elsewhere noted : Songadh (Navsari Dist.); Waghai, Galkund (Surat Dangs).

Measurements :	W	B	Tar.	T
4 ♂♂ ad.	134–141·5	31	25–26·5	84–88·5
1 ♂ imm. plum.	135	30	24	91
4 ♀♀ ad.	132–137	28–30·5	23·5–25·5	83–87·5

The two specimens of the GS series are in fresh adult plumage with extensive yellow edging to the inner secondaries and tertiaries. In this respect they match perfectly birds from the Prome and Thayetmo districts of Burma (in B.N.H.S. collection) determined by Dr. C. B. Ticehurst as *xanthornus.*

Common and resident in the better wooded portions of the area. Affects deciduous forest, particularly where hilly and with a mixture of teak and bamboo. The hot hours of the day ring with its fluty melodious calls and harsh *kwaaks.* One in a leafy banyan, during the mid-day heat, spent over 15 minutes at a stretch soliloquising in broken notes—syncopated mellow calls jumbled with harsh ones—reminiscent of the composition of a Rufousbacked Shrike. Not observed in Kutch or Saurashtra, though in the latter it doubtless occurs in the Gir area of Junagadh.

Family DICRURIDAE: DRONGOS

Dicrurus macrocercus peninsularis Ticeh. The Indian Black Drongo.

Specimens collected: Kutch: KS100 ♀ 21-8-43 Chaduva (Bhuj Dist.); KS115 ♀, KS116 ♂ 25-8-43 Mandvi; KS424 ♀ 31-3-44 Bela Island (Great Rann). Gujarat: GS136 ♂ 5-11-45 Bodeli (Baroda Dist.); GS218 ♀ 10-11-45 Jambughoda; GS732 ♀ 26-12-45 Patan (Mehsana Dist.).

Saurashtra: GS1016 ♂, GS1017 ♂ 16-3-46 Dalkhania (Amreli Dist.).

Elsewhere noted: Kutch: Khari Rohar; Anjar; Khavda; Chobari (Bhachau Dist.); Khadir Island (Great Rann); Pung Bet (Little Rann). Gujarat: Baroda; Dabka; Cambay; Radhanpur; Deesa; Palanpur. Saurashtra: Amreli; Okha; Dwarka; Ghatwad (Kodinar); Rajkot; Jamnagar.

Measurements:	W	B	Tar.	T
2 ♂♂ ad.	141·5–142	26	21–22	93–145/95–152
2 ♀♀ ad.	140–142	22·5–25	20–23	94–151/98–154

Rest of the specimens not measured as either 1st year or in moult.

Resident. Common. Evidently subject to considerable local movement the nature of which is not properly understood. During the Kutch Survey, at the extreme NW. tip of Khadir Island (26-3-44) I counted one morning at about 9-30 o'clock at least 20 birds in about 45 minutes coming over steadily in loose twos and threes, roughly in a NE. to WSW. direction at a height of 20 feet or so, across the wide expanse of the open treeless Rann. The passage appeared to be continuing.

The Black Drongo is also met with commonly on the 'bets' or small flat grassy 'islets' in the Little Rann which are virtually tiny oases. One was observed riding on the back of a grazing wild ass (*Equus hemionus*)!

The nesting season in Kutch is April to July. Complete post-nuptial moult takes place about August.

In Cambay, where the local name of the bird is 'Kosita', a villager supplied the following prescription which is apparently fairly generally known and believed to be efficacious: 'Boil a kosita, feathers and all, in about 4 seers of water. Pour over head and bathe woman after childbirth. All pains in back etc. vanish.' Curiously enough, in another part of Gujarat (Palanpur) the same treatment is practised with much alleged success, but using the Grey Hornbill ('Chalotra') as the basic ingredient!

Dicrurus leucophaeus longicaudatus Jerdon. The Indian Dark Ashy Drongo.

Specimens collected: Gujarat: GS416 ♂ 29-11-45 Cambay; SD27 ♂ 25-2-48 Malegaon; SD251 ♀ 11-3-48, SD265 ♂, SD266 ♂ 12-3-48 Laochali; SD326 ♀, SD327 ♀ 16-3-48, SD349 ♂, SD350 ♂, SD351 ♀ 17-3-48 Mheskatri; SD382 ♀ 20-3-48 Sarwar (SD = Surat Dangs).

Elsewhere noted Gujarat: Songadh (Navsari Dist.).

Not met with in Kutch. I have examined a vagrant shot in the well-wooded grounds of Vijaya Vilas Palace, Bhuj, by K. S. Fatehsinhji on 17-11-54.

Measurements:	W	B	Tar.	T
5 ♂♂ ad.	136–148	25–28	18–20	90–98/140–173
5 ♀♀ ad.	136–144	25–28	18–20	89–96/155–168

Status? Presumably winter visitor (from the peninsular hills?; Himalayas?). All the March specimens were in more or less heavy moult, and most of them very fat suggesting that the birds were preparing to emigrate. Its favourite habitat was broken hilly country under bamboo and mixed deciduous forest.

One of its commonest calls is a pleasant, musical, querulous *kil-kil-kil-kil-kil*, very like that of the Striped Squirrel (*Funambulus pennanti*). It also utters a harsh, challenging *chees-chees-chichuk*.

Commonly seen hawking winged insects from tree-tops well into evening dusk.

Dicrurus caerulescens caerulescens (Linn.). The Whitebellied Drongo.

Specimens collected: Gujarat: GS92 ♀ 1-11-45 Ajwa (Baroda Dist.); GS417 ♀ 29-11-45 Cambay; GS654 ♀ 19-12-45 Vaghjipur (Mehsana Dist.); GS930 ♂ 18-1-46 Balaram (Palanpur); GS1134 ♂+ 29-3-46 Dediapada (Rajpipla); GS1299 ♂, GS1300 ♀ 20-4-46, SD101 ♀ 1-3-48 Galkund; SD12 ♂+ 24-2-48 Malegaon; SD167 ♀+, SD168 ♂+ 5-3-48, SD190 ♂+ 6-3-48 Pandwa; SD383 ♂+ 20-3-48 Sarwar (SD = Surat Dangs).

Elsewhere noted: Gujarat: Patan (Mehsana Dist.); Songadh, Medha (Navsari Dist.); Radhanpur; Juna Rajpipla; Mahal, Ahwa (Surat Dangs). Saurashtra: Okha.

Measurements:	W	B	Tar.	T
7 ♂♂ ad.	122–135	24–25·5	19–20	88–89/115–130
6 ♀♀ ad.	120–129	23·5–27	19–21	91–95/116–128

Resident. Common in secondary mixed deciduous jungle, and here partial to the bamboo facies. Also affects wooded compounds, and is fond of hawking winged insects from tree-tops through evening dusk till almost quite dark. Has a number of pleasant musical calls, and is a good mimic of other birds.

All the specimens collected in March had enlarged gonads and were evidently breeding or about to breed. On March 2 (Galkund, Surat Dangs) a nest was found 30 ft. up a teak sapling in a fork of the end twigs of a bare horizontal branch. It was almost completed with the bird sitting within and turning round and round to give shape to the cup.

The sight record from Okha (Saurashtra) is noteworthy. The bird—the only example seen—was obviously a newcomer. It must have travelled a considerable distance over practically treeless country, totally unsuited to its requirements, and was keeping to some recently grown trees in the port area. The advent and establishment of bird species at Okha—heretofore a barren semidesert tract—following on its development as a seaport and the planting of trees around the human habitations, is an interesting subject for ecological study.

Dicrurus paradiseus malabaricus (Latham). The Malabar Racket-tailed Drongo.

Specimens collected: Gujarat: GS1094 ♂+, GS1095 ♂+ 25-3-46, GS1127 ♀ 27-3-46 Juna Rajpipla; GS1268 ♂+ 14-4-46 Waghai; SD11 ♂ 24-2-48, SD94 ♀ 29-2-48 Malegaon; SD249 ♂+, SD250 ♀ 11-3-48 Laochali; SD291b ♀ 13-3-48, SD294 ♂ 14-3-48 Mahal; SD339 ♀ 16-3-48 Mheskatri (SD = Surat Dangs). Absent in Kutch.

Measurements:	W	B	Tar.	Centr. T	Rackets
5 ♂♂ ad.	156–166 (average 160)	35·5–41	26–28	133–142	285–385
5 ♀♀ ad.	150–160 (average 153·8)	35–37	26–27	129–136	310–352

All the above have the short crest and short hackles on hindneck which characterize this race.

Resident. Common in bamboo and mixed deciduous forest south of the Narbada River. In the Surat Dangs it is one of the 5 commonest bird species in this biotope, the others being *Hypothymis*, *Glaucidium*, *Dicrurus caerulescens* and *Crypsirina*. The specimens of March and April showed progressively enlarged gonads indicating that breeding was imminent.

Exceedingly noisy in the mornings, starting before dawn (*ca.* 4.30 a.m.) with a desultory, monotonous *kit-kit-kit-kit* etc. which is kept up almost continuously till daybreak. An accomplished mimic, imitating to perfection almost every bird call in the forest. On one occasion the report of a gun set it off crowing like a Grey Junglecock. It repeated this several times and so flawlessly, with all the appropriate pauses, that even the Dangi Bhils accopanying me were completely deceived. The bird gave itself away only when it stopped abruptly once or twice right in the middle of a crow. I frequently found bunches of this drongo's feathers scattered on the ground in forest, suggesting that it sometimes falls a prey to predatory hawks. Can it be that its general obstreperousness and mimicry of their calls bring about its undoing? On one occasion, at any rate, this undoubtedly was the case. I heard one imitating—almost mocking—a Shikra (*Astur badius*) for a considerable time. Very soon afterwards this individual was seen hotly pursued by a shikra which finally struck it down and devoured it on the ground, leaving bunches of its feathers strewn about. On another occasion a bird echoed back, promptly and without hesitation, the signal whistle of a member of my party with the identical note!

Family CORVIDAE: Crows

Crypsirina vagabunda pallida Blyth. The Northern Tree Pie.

Specimens collected: Gujarat: GS399 ♂ 28-11-45, GS491 ♂ 6-12-45 Cambay, GS577 ♀ 15-12-45, GS600 ♀ 16-12-45, GS622 ♀ 17-12-45, GS626 ♂

18-12-45, GS651 ♀, GS652 ♀ 19-12-45 Vaghjipur (Mehsana Dist.); GS734 ♀ 26-12-45 Patan (Mehsana Dist.); GS885 ♀ 11-1-46, GS919 ♂ 14-1-46 Deesa (Palanpur); GS1301 ♀+ 20-4-46 Galkund (Surat Dangs); SD20 ♀ 25-2-48 Malegaon; SD34 ♀ 26-2-48, SD116 ♀ 2-3-48, SD138 ♀ 3-3-48 Galkund; SD348 ♀ 17-3-48 Mheskatri; SD388 ♀, SD389 ♂+ 20-3-48 Sarwar; SD431 ♀ 22-3-48 Pimpri (SD = Surat Dangs). Saurashtra: B26 ♀ 17-10-43 Amreli; GS988 ♂+ 15-3-46, GS1014 ♀ 16-3-46 Dalkhania.

Absent in Kutch.

Measurements:	W	B	Tar.	T
6 ♂♂	155–168	33–36·5	32·5–37	247–270
17 ♀♀	144 (1), 146–162	30–34·5	32–37	205 (1), 209–267

In size this series averages larger than either *vagabunda* or *vernayi*, but the birds are somewhat smaller than *pallida* of NW. India. In colour they are inseparable from *pallida*. A specimen from Amreli (No. B26) is very small (W 146 mm.) and would pass for immature *vagabunda*, but on the whole Saurashtra birds go better with those from Gujarat.

Common in all the better wooded portions of the area. Abundant in the Mehsana District, the Songadh section of Navsari Dist. and the Surat Dangs. In the latter locality it was one of the five commonest bird species in bamboo and mixed deciduous forest, the others being Quaker Babbler, Blacknaped Blue Flycatcher, Tickell's Blue Flycatcher and Racket-tailed Drongo. Its complete absence from Kutch seems noteworthy since there are many localities there which seem eminently suitable for it. It is not uncommon in N. Gujarat, parts of the Kathiawar peninsula and portions of the Indus Valley and canal areas of Sind. The Great and Little Ranns which insulate Kutch from the mainland to N. and E., and the Gulf of Kutch which cuts it off from Saurashtra to the south, appear to constitute effective barriers to its spread, as they seem also for another common bird, the Jungle Babbler, which is likewise absent in Kutch.

From the state of the gonads and the noisy and excited, yet characteristically secretive, behaviour of the birds it was evident that nesting was in progress during March and April. The pair of March 20 (Nos. SD388/389) were courting noisily, bobbing up and down stiffly at each other like mechanical toys—bills, almost touching—and uttering musical croaks and harsh chuckles.

Corvus splendens splendens (Vieillot). The Indian House Crow.

Specimens collected: KS29 ♂ + 10-8-43 Bhuj; KS339 ♀, KS340 ♀ 8-3-44 Mandvi. Gujarat: GS187 ♂ 8-11-45 Bodeli (Baroda Dist.); GS838 ♀ 5-1-46 Radhanpur. Saurashtra: B11 ♂ 13-10-43 Dwarka (Okhamandal): GS1010 ♀, GS 1011 ♂ 16-3-46 Dalkhania (Amreli Dist.).

Measurements:	W	B	Tar.	T
3 ♂♂	271–284	51·5–56	45–51	166–175
3 ♀♀	263–282	45–50	44–48	158–175

General post-nuptial moult in October-November.

Very common and abundant in the whole area, in towns and villages. Also out on the countryside, often in greater numbers than the available scavenging there would appear to warrant. Enormous numbers flight at sunset over considerable distances to roost in groves of large trees in concert with parakeets, mynas and (in season) rosy pastors.

Noted as particularly destructive, in Kutch, to eggs and young of egrets, pond herons, white ibises and spoonbills etc., nesting in mixed heronries. Does useful scavenging in towns, but also quite appreciable damage to groundnuts in outlying areas, pilfering the pods from the fields as well as from stacked sacks.

It is worth remarking that the House Crows of Kutch belong to the Indian race and not to the pale-collared form, *zugmeyeri*, of Sind as one would expect from the physiography of the country. The Great Rann apparently acts as a barrier to the spread of *zugmeyeri* here. The breeding season is chiefly between June and August.

Corvus macrorhynchos culminatus Sykes. The Indian Jungle Crow.

Specimens collected: GS121 ♀ 3-11-45 Ajwa (Baroda Dist.); GS608 ♂ 17-12-45 Vaghjipur (Mehsana Dist.); GS1131 ♀, GS1132 ♀ 29-3-46 Dediapada (Rajpipla).

Absent at Kharaghoda; Radhanpur; Patan (Mehsana Dist.); Deesa; Palanpur. I did not come across it in Kutch, but according to the late Maharao Vijayarajji the bird has (or had in 1943) established itself in small numbers at Mandvi within recent years, and breeds there. A pair had also been reported from the Bhuj neighbourhood and its further spread to the blank areas may be watched for with interest.

Measurements:	W	B	Tar.	T
1 ♂ ad.	319	58	59	185
2 ♀♀ ad.	290–297	59–60	52–54	165–180

Observed damaging standing bajra crops, occasionally wrenching off an entire cob and carrying it to a nearby tree to deal with.

No sign of breeding was noted.

Corvus corax laurenci Hume. The Punjab Raven.

Specimens collected: Kutch: KS428 ♂+, KS429 ♀ 25-2-46 Nanda, near Adesar (Little Rann).

Elsewhere noted: Kutch: Nir (Pachham Island); Dholovira (Khadir Island) in the Great Rann.

Measurements:	W	B	Tar.	T
1 ♂	420	74	65	229
1 ♀	410	69	62	223

Both completing primaries moult, otherwise in fresh plumage. Testes 5×4; ovary dormant. Apparently a sparse winter visitor. Singly or pairs seen about outlying homesteads and shepherds' encampments in semidesert country.

The above was a pair feeding near my camp on the edge of the Little Rann at the carcase of a wild ass, in company with *C. splendens*.

Concluded.

MISCELLANEOUS NOTES ON INDIAN BUTTERFLIES

BY

D. F. SANDERS

The main purpose of these notes is to shew that the recorded distributions of several of the butterflies of our region, (*vide* below), are too circumscribed, but I have also included other information, e.g. as to habitats, habits, etc., and some descriptions of some hitherto unknown or undescribed subspecies and sexes, which will, I trust, prove of interest to collectors.

'Our region' comprises the whole of India and Pakistan, Burma and Ceylon, (excluding the Andaman and Nicobar Islands), and my observations do not include the Hesperiidae.

Attention is invited to the following new information:—

Descriptions of the females of *Papilio polyctor stockleyi* Gabriel, *Eurema simulatrix sarinoides* (Frühstorfer), *Dodona henrici longicaudata* De Niceville, Dry Season Form, and *Rapala abnormis* Elwes; descriptions of *Lycaenopsis ceyx cerima* Corbet[1], male, *Amblypodia* ?spec. nov., male, and *Horaga amethystus purpurascens* Corbet, male and female.

I am very happy to acknowledge the valuable and ungrudging help received from Brig. W. H. Evans, C.S.I., D.S.O., etc., at the British Museum, who was always ready to assist me with the identification of doubtful species and races, and the great help afforded by Dr. H. A. Baylis, M.A., D.SC., lately Dy. Keeper of Zoology at the British Museum (Natural History), who examined for me the androconia of several specimens of sundry species of *Lycaenopsis*, notably *argiolus sikkima* Moore and *jyneana* De Niceville, which were treated as separate species in the 2nd edition of Evan's 'Identification', but now, as an off-shoot of these examinations, are regarded by him as one and the same species, namely *argiolus jynteana* De Niceville.

These notes were commenced prior to the partition of India and Pakistan, but, for sundry reasons, I was unable to complete them until recently. Wherever, therefore, the context admits, 'India' must be understood as including 'Pakistan' and Provinces such as Bengal and the Punjab as covering the Provinces of these names in the days of British India.

The nomenclature adopted is that given in the Fauna of British India, Butterflies (2nd edition) by Talbot, for the families Papilionidae, Pieridae, Danaidae, Satyridae, Amathusiidae, and Acraeidae, and that employed in Evans's 'Identification', 2nd edition, for the Nymphalidae, Erycynidae and Lycaenidae.

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[1] This insect has recently been described by Dr. T. Norman, in Vol. 51, No. 2, of the Society's journal, from a male taken in Assam, but I took my specimens in 1939 and wrote my description before the discovery of the insect in Assam and am therefore including it here, for what it is worth.

Atrophaneura priapus egertoni (Distant).

While collecting around the Bwabin Tin Mine, near Wagon, about 20 miles east of Tavoy, S. Burma, early in 1939, I saw flying toward me what I at first took to be a worn female of *Papilio memnon agenor* Linnaeus, but noticed something unusual in its appearance as it approached me and took it, when, to my surprise, it proved to be a female of *priapus egertoni*, with, alas, the tornal parts of the hind wings torn off, probably by a lizard; these creatures spoil for the collector many a freshly-emerged butterfly in Burma, in that manner. The butterfly has hitherto only been recorded from the Mergui Archipelago, but will probably be found to inhabit the hilly country from Tavoy to the extreme south of Burma. I also saw a female ovipositing in a forest near Mergui, in January 1939, but it never came within reach of my net or indeed to below about 30 ft. from the ground.

Atrophaneura aristolochiae aristolochiae (Fabricius).

I once took a rather worn specimen in a garden in Hyderabad (Deccan), which shows no sign of any reddish or white spots on the hind wing. I can find no other record of the capture of such an individual form.

Atrophaneura latreillei latreillei (Donovan).

Talbot states 'more common in Mussoorie than elsewhere. Only found at high elevations between 7,000 and 9,000 ft.' My collector took it in the neighbourhood of Chungthang, in the Tista Valley in Sikkim, at about 5,000 to 6,000 ft. in such quantities that if it *is* commoner in Mussoorie it must positively swarm there. I also took a few specimens in the same locality towards the end of May, 1943.

Papilio polyctor stockleyi Gabriel.

Talbot states 'The Dawna Range southwards . . . Only 2 males at present known, both in the British Museum.' I was fortunate enough to take a female, unluckily in very damaged condition, in Kalaw, S. Shan States, in June 1939. It is indistinguishable from the (description of the) male, save that the green stippling of the upperside of the forewing is less dense and the shape of the wings is broader than those of the male. The range of the insect must be extended to at least the S. Shan States in N. Burma.

Papilio arcturus arcturus Westwood.

This insect is generally rather constant in coloration and markings but I have a male of the dry season form, taken towards the end of May, 1944, near Chungthang, Tista Valley, at about 5,000 ft., which is markedly smaller than the average, the green band on the forewing upperside being broad and outwardly diffuse and tinged with yellow. The greenish patch on the hind wing upperside is broader and much greener than usual and there is a prominent claret band, not separate lunules, postdiscally in interspaces 1 a to 4, u.p.h. The specimen looks rather like a hybrid between *krishna krishna* Moore and *arcturus arcturus* Wd. Could that be what it is?

Papilio krishna krishna Moore.

Talbot states that this insect frequents bare places on mountains where the slopes are covered with forests of chestnut, oak and magnolia. The male however also drinks at puddles and sandy patches on paths and roads through forests, like its congeners.

Papilio crino Fabricius.

Talbot says that this species occurs in Ceylon, Peninsular India and lower Bengal, being rather common in the plains. In my experience, it is extremely rare in Hyderabad (Deccan) and distinctly uncommon near Calcutta.

Papilio dravidarum Wood-Mason.

Talbot states that the male is usually common and that the insect is common on the western slopes of the Nilgiris, while T. R. Bell, quoted by him, says that in Kanara it is not often seen at flowers. I found the insect fairly common at the foot of the Lakkidi Ghat, leading from the Nilgiri Wynaad to the Calicut district, in early August, 1929, during an extremely wet spell. The males came eagerly to flowers whenever the rain abated for a minute or two and the females less frequently.

Papilio polytes romulus Cramer.

Mr. D. G. Sevastopoulo, in a note, if I remember right, in your journal in or about 1942, stated that in breeding experiments he found the female form *cyrus* Fabr. as common as the other forms. Both Evans and Talbot state that this form is rare or the least common of the female forms, and my experience confirms this. I was constantly on the look-out for the *cyrus* form in Calcutta but found very few, although I was able to distinguish the female from the male when the insect is sipping nectar from a flower; and, although I reared several larvae, taken at random, of this species on several occasions, I never succeeded in obtaining a *cyrus* form in that manner. Could Mr. Sevastopoulo have struck an unusually high percentage of *cyrus* forms?

Teinopalpus imperialis imperialis Hope.

I found a few of these insects flying fast and high around the 'Observatory' on Tiger Hill, near Darjeeling, in June 1943, in the sunshine. As soon as a cloud or mist obscured the sun, they would fold their wings back and drop like stones usually on to small bushes in the vicinity, but even on to the grass in the Observatory enclosure; they would sit tight at rest and be very difficult to see owing to the coloration of the undersides, until the sun emerged again. While thus at rest they could be taken with the fingers.

PARNASSIINAE

Talbot remarks on p. 259 of Vol. 1: 'The classification of a number of the Indian forms is still in a state of uncertainty, owing to the lack of material. In the present volume, several forms are treated as races upon a consideration of the distribution: such treatment is provisional, and the acquisition of more material is much to be desired in order to obtain a more accurate conception of these forms.'

He also says, *vide* p. vi of the Author's preface in the same volume, that there is much confusion in the genus *Parnassius*, and this is unlikely to be cleared up until more intensive collecting can be done in the higher Himalayan valleys and adequate data obtained: it is not enough to have the name of a locality and the month of capture; it is important to know what forms actually fly on the same ground.

In view of these remarks, the following observations from my own rather limited experience may be of some interest, even though *per se* they throw little light on the subject.

I made a collecting trip in the summer of 1939 from Srinagar to Gilgit via the Burzil Pass and on to the Shandur Lake, whence I entered Chitral and travelled NE. to the Baroghil Pass, crossing the Darkot Pass a little further on into Yasin and so back via Gilgit and the Kamri Pass to Srinagar. References in the following items to butterflies occurring within this area are therefore concerned with this trip, unless otherwise stated.

I crossed the Rajdiyangan Pass, 11,900 ft., slightly beyond Tragbal, on July 9th, but found no Parnassiids on or near the Pass either on my outward, or return journey on the 16th September.

I collected around and above the Burzil Pass on the 14th to 17th July inclusive. On the sunny slopes above the pass and in the valley leading to the pass from the south, I found a few *P. hardwickei hardwickei* Gray at from about 12,000 to 13,000 ft., but nearly all were worn, and it would therefore appear that they must begin to emerge in this locality before the end of June. *P. charltonius ?deckerti* Verity was fairly common and in reasonably good condition from about 13,000 to 14,500 ft., but, as usual, difficult to capture. *P. stoliczkanus nicevillei* Avinoff was moderately common from about 13,500 to 15,000 ft. but it was difficult to find fresh specimens. *P. epaphus ?hinducucica* Bang-Haas and *P. simo* ssp. were flying uncommonly from about 14,500 to 16,000 ft., the former on the grassy slopes near the snow-fields and the latter on slopes covered by loose, grey, shale, where they were difficult to see when settled, and to catch owing to the slippery nature of the shale. *P. epaphus* were freshly emerged and I saw no females, but *P. simo* were nearly all very worn and must have been on the wing for two or three weeks. This insect has not been recorded from this locality previously; it seems nearest to ssp. *saserensis*. All the last named four can be found flying together in some parts of their range and season. *P. jacquemontii jacquemontii* Boisduval was not in evidence on this occasion. Two males of the *P. simo* were presented by me to the British Museum.

I arrived at the Shandur Lake, (about 12,000 ft.) on the evening of the 6th August and collected in the neighbourhood from the 7th to the 11th of that month inclusive.

I had come across a few worn specimens of *P. tianschanica binghami* Bryk on the 'road' from Teru to Shandur, at about 11,000 ft., on the 6th, and those that I found on the borders of the lake were in very poor condition; but on the slopes above the lake, to the west, the same species was fairly common and fresh, from about 13,000 to 14,000 ft. A fair number of *P. charltonius ducalis* Boullet & Le Cerf in fair condition, were flying at about 13,000 to 14,000 ft. also, in company with the *tianschanica*'s while *P. delphius chitralica* Verity were common at from 13,500 to 15,000 ft., but very few were found, out of a large number taken, to be in good enough condition to be worth keeping. *P. epaphus ?hinducucica* Bang-Haas were rare but freshly emerged at about 14,500 to 15,500 ft. and upwards. These four subspecies therefore all fly simultaneously for some part of their season and range and at similar or overlapping altitudes.

I reached the Baroghil hut, near the pass of that name, on the 20th August and spent three days collecting in the neighbourhood. The slopes south of the river which flows down below the hut, facing north and leading up to above the Darkot Pass, provided good hunting, and I found *P. jacquemontii chitralensis* Moore in numbers and fairly fresh condition there at about 12,500 to 13,500 ft. *P. delphius* ssp. occurred quite commonly from about 13,000 to 15,000 ft. and even upwards, but most frequently between 14,000 and 15,000 ft. I captured a large number, but 75% were worn specimens and had to be released; I was, however, able eventually to secure a fair series. The subspecies occurring here seems to approach (the description of) race *hunza*, especially in the reduced discal markings, but Brig. Evans, on a comparison of a series of my specimens with the British Museum's series of ssp. *chitralica* and *hunza*, considered that mine were probably a seasonal form of the former. In view of the time of their capture and the small amount of the SW. monsoon rainfall in these parts, they may well have been a second dry-season brood, the earlier brood, if one exists, being more like a wet-season form emerging while the ground is saturated with the recently melted snows. I presented two males and two females to the British Museum and, perhaps, when the genus is revised a more definite view may be expressed. The only other Parnassiids I found in this locality were a few very elderly, worn, pale specimens of *P. thianschanica*, which seemed to be too faded to be worth taking. I had at the time only Evans's 'Identification', 2nd edition, in which the species is not split into any races in the Indian area, but, on obtaining later a copy of Talbot's Fauna of British India, 2nd edition, I wondered whether these specimens could have been another race and regretted that I had kept none. They were only seen at about 12,000 to 12,500 ft.

I crossed the Kamri Pass, on my way back, on the 13th September in a snow blizzard, but revisited the Pass the following day in fine weather. I saw no butterflies there, except one worn *Lampides boeticus!*

Talbot, in a note on *Maniola hilaris* on page 266 of the 2nd edition of the Fauna, Vol. 2, seems to imply that the slopes on the northern side of the Darkot Pass are not in Indian territory, but if he refers to the slopes which divide the two great glaciers which join to form the summit of the Pass, where I took the Parnassiids mentioned, he is surely wrong; for these slopes lie to the north of the pass and face more or less north, but are south of the river which divides the Thui Range from the Hindu Kush, in which the Baroghil Pass is situated.

On the track from the Baroghil Pass to the eastern arm of the glacier leading to the Darkot Pass, at about 12,000 to 12,500 ft. and on the western moraine of the glacier, up to about 13,500 ft., the only Parnassiids seen by me were a few worn *P. charltonius* (?) *ducalis*.

Aporia agathon ariaca

Talbot states that this race is known chiefly from Naini Tal and is not common. In May 1945 I found it plentiful on the road from Almora to Bhinsar, and in June of that year it positively swarmed in one locality on the old short bridal path from Naini Tal to Bhowali. Every thistle head and several other flowers had three or four of these butterflies clustered on them. They should therefore be classified probably as very common but rather local.

Delias singhapura singhapura

On a path to the top of the hill on Pataw Island, opposite Mergui, I was watching a pair of *Delias* butterflies flying around among the foliage of some tall trees when they began to indulge in a love flight and fell entwined just in front of me and I was able to capture them. They proved to be specimens of the rare species named. They seem to have the habit of several of the genus, of flying about the tops of trees or resting on the leaves near the tops during the heat of the day.

Delias sanaca sanaca, form confusa

Talbot says that from *confusa* is rare and may be said to range from Kulu to Kumaon; he states that the description of the female given by him is the first record of the female of this form, being taken from the insect found by Lt.-Col. H. D. Peile dead on the ground at Mussoorie, at 5,500 ft., in May 1916. Towards the end of May 1945, at Bhinsar, in the Almora District, and in the first half of June of the same year around Naini Tal, I found what agrees with the description of this form common, the females scarcely less plentiful than the males. Both sexes spent a good deal of time during the heat of the day flying high around trees, where they were inaccessible, but they also haunted shady nalas and streams, especially in the afternoon, and seemed to enjoy sitting on the mossy banks of the latter, where they received a sprinkling of cool spray. Moreover, I was sent a few specimens of this subspecies in two or three successive years by a friend from Naini Tal and it would appear that form *confusa* is now the commonest, and in fact the normal, form in Kumaon.

Delias acalis pyramus (Wallace).

Under the *species*, Talbot gives the distribution as '. . . Simla to Burma . . .', but under the subspecies *pyramus*, the northern race, he shows the habitat as Nepal to Burma. Evans gives the distribution of this race as Simla to Burma. I have not taken it or received it from west of Sikkim, (I exclude Nepal, as it is not within our area,) and it would be interesting to know which habitat is correct.

Delias agostina agostina (Hewitson).

Talbot says it occurs from 3,000 to 8,000 ft. It can be taken quite commonly along the Tista Valley, in the Darjeeling District, at 1,000 ft. and upwards to about 3,000 ft., but I have never come across it above that altitude.

Delias hyparete ethire Doherty.

Talbot says it is more common in the Madras district but recorded by Taylor (1888) as being very common at Khurda, in Orissa. I can confirm that this subspecies occurs at Khurda, in Orissa. I also found it rather uncommon at Taptapani near Berhampore, in the Eastern Ghats, but I searched for it in vain around Calcutta. That does not prove that it does not occur in Bengal, but presumably it is confined to the south of the Province. I also found it rarely in and around Hyderabad (Deccan).

Cepora nadina remba (Moore).

Talbot says it does not usually frequent flowers and rarely rests on leaves in open places, so that it is not easy to catch, but at Mahableshwar in February 1946, I found the males commonly, and the females rarely, on flowers and leaves beside the broad drives through the forests, and the males frequented damp, sandy spots in stream beds along with *nerissa phryne*, its congener.

Appias indra indra (Moore).

The males congregate commonly at damp places in stream beds and, when disturbed, delight to play follow-my-leader in circles around the place where they were sitting, until they deem it safe to resume their sipping. Other species are recorded as indulging in the same habit.

Pieris krueperi devta (de Niceville).

I took a few specimens of this insect in late July and August, on my trip previously mentioned, in Gilgit and Chitral at elevations of about 9,000 to 12,000 ft. They were nowhere common and I seldom saw more than one or two in a day. They seemed to float down the hill-sides to flowers beside the 'road', between 11 a.m. and 1 p.m., and thereafter to disappear up the rather barren slopes above it. When settled, their blotchy undersides made them very difficult to spot and they never gave one a second chance if missed.

Pieris dubernardi chumbiensis (de Niceville).

I note that Talbot follows previous authors in regarding the Chumbi Valley as situated in Sikkim. It surely lies wholly east of the Donkya Range, which separates Sikkim on the east from Tibet, and is therefore in that country. If this assumption is correct, several species hitherto classified as 'Indian' must be excluded from that category, e.g., *Pieris napi melaena*, *Aulocera brahminus brahminus.*[1] *Vanessa antiopa yedanula*, etc., and some Lycaenids.

Euchloe ausonia daphalis (Moore).

Brig. Evans, quoted by Talbot, notes that this insect is fairly common in Chitral in March and April, between 5,000 and 8,000 ft.; and says:—'It is local and has one brood, which . . . appears in the latter half of April'. I took a freshly emerged male near the Burzil dak bungalow in mid-July 1939 at about 11,000 ft. but failed to find any more. Was this a member of a second brood or merely one whose emergence had been delayed by the severer conditions prevailing at that altitude?

Catopsilia pyranthe pyranthe (Linnaeus) and **C. florella gnoma** (Fabricius).

The uncertainty as to whether these are one and the same species, with *florella* only the dry-season form of *pyranthe*, has apparently not yet been dispelled. Talbot records that the dated specimens in the British Museum (of *florella*) were taken from December to April, whilst those of *pyranthe* were taken from June to December, and is inclined to think that they are seasonal forms.

I have series of dry-and-wet season forms of both 'species' from several localities in the plains of India, but the *pyranthe*-like specimens are far the commoner in the monsoon months and the *florella*-like specimens much the more plentiful in the dry months. I have also taken dry-season-like forms during the monsoon months and wet-season-like forms during the dry months, especially in places such as Calcutta where long periods of unbroken drought are exceptional. My experience therefore tends to support the assumption that these are separate species, but it admittedly proves nothing!

Gandaca harina assamica Moore.

I took a few specimens of this butterfly, none of which was in perfect condition, at Christmas and in early January, at Taptapani, Ganjam, (*vide* under *hyparete ethire* above), on two visits of a few days each to Gopalpur. It has not, I believe, been recorded previously except from Sikkim to Assam. The differences between these specimens and specimens in my collection from Sikkim are very slight, the black border being a little broader at the apex of the forewing upperside, in the former, and not continued quite so far down the termen, ending generally above vein 3 and becoming thread-like about vein 5 in the male and ending well above vein 1 in the female, which is faintly tinged with yellow. Brig. Evans, to whom I showed my series from Taptapani, considered that they were not sufficiently differentiated to constitute a good separate subspecies, but it would be interesting to know whether this view can be upheld when more material is available for comparison.

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[1] *Brahminus* is also found in other parts of the Indian Himalaya.—Eds.

Eurema simulatrix sarinoides (Frühstorfer)

I took a fair series of this insect, including a few females, in November-December 1938 and January-February 1939, in Tavoy, Mergui, and the eastern foot of the Dawna Hills near Thingannyanaung. I showed them to Brig. Evans at the British Museum, and he confirmed that they were undoubtedly this subspecies. Talbot says, (December 1938), that the female of this butterfly does not appear to be known and there were no females of it in the British Museum collection in 1947. I therefore presented a pair to the Museum and presume that the female is the allotype. Subsequently a report of the discovery of the female in Arrakan appeared in a list of Arrakan Butterflies, by J. C. Gladman, in the *Journal of the Bombay N.H.S.* in 1948, I believe, but cannot now trace the correct reference. I was particularly on the look-out for this insect during my collecting trip in Burma from November 1938 to early June 1939, and was glad to have come across it on several occasions. I consider that it is not as rare as it has been thought to be, but is liable to be overlooked owing to its similarity in the field to other species of the genus, and, especially when settled, to wet season forms of *blanda silhetana* and *sari sodalis*.

It is evident from the above that my specimens were all taken in the dry season, but all have well marked and fairly broad black borders on the hind-wing upperside, distinctly scalloped anteriorly and intensely black in the males, (*pace* Talbot, who figures and describes what must be an extreme dry season form). The female very closely resembles the male but, on the upperside, the black of the borders is less intense than in the males, the ground colour slightly paler and the forewing slightly broader. The markings and colour of the underside are indistinguishable from those of the male.

Colias alpherakii chitralensis Verity.

When I reached the Shandur Lake (on August 6th), I was too late to find this insect in good condition especially at the lake level. The few I saw were very old and worn; but higher up the slopes above the lake, to about 14,000 ft., I came across ones or twos, mainly females, in fair condition. Also on the 4th August I took a female near Ghizar Fort, about 20 miles from the Shandur Pass on the Gilgit side, in poor condition; and I captured another on the slopes leading down from the Darkot Pass towards Darkot, i.e. on the southern side and in Yasin, N. Gilgit, at about 13,000 ft., on the 24th August, also very worn. This butterfly may therefore now be recorded as occurring in N. Yasin and W. Gilgit, as well as in Chitral.

Colias wiskotti wiskotti Staudinger & Bang-Haas.

On the same day and within a few minutes of taking *C. alpherakii chitralensis* near Ghizar (*vide* above), I captured a very common female of *wiskotti*. It appears to occur, therefore, in W. Gilgit, as well as in Chitral. I did not find this insect near the Shandur Lake and next came across it near the Baroghil Pass, (NE. Chitral), at about 12,500 ft. and along the track from the Baroghil Hut to the foot of the eastern arm of the glacier leading to the Darkot Pass. I was too late to find any in good condition; the few I saw and took were lamentably elderly and worn.

Colias electo fieldii Menetries.

Near Shankergarh on the road to the north side of the Kamri Pass, at about 11,000 ft., on the 11th September 1939, I took a fresh male of this insect, the ground colour of which was a deep gamboge yellow instead of the normal orange. It was otherwise indistinguishable from the usual form.

Danaus melanippus indicus (Frühstorfer).

Recorded by Evans and Talbot from Bengal but, at any rate near Calcutta, it is very rare, and in many years there I only saw three or four. I did, however, see a specimen in a casuarina wood near Puri, Orissa, at Christmas time; it settled quite near me and was unmistakable, but in attempting to catch it, I caught my net on a twig and the insect escaped. Orissa may therefore be added to its habitat.

Danaus aglea aglea (Stoll).

Recorded from Ceylon and Southern India to Orissa, but I have found it rare near Calcutta in many years. Bengal should be added to its distribution.

Euploea mulciber kalinga Doherty.

Doherty, quoted by Talbot, says he found this insect common in parts of the Eastern Ghats; but Talbot states that it is rare in collections and that there are no specimens of it in the General Collection at the British Museum. I found a few of both sexes at Taptapani, in the Eastern Ghats west of Berhampur (Ganjam); one at Christmas time, it may be of interest to note.

Mycalesis igilia igilia Frühstorfer.

Recorded by Talbot only from Coorg and Mysore, but I have taken it at Gudalur (on the Mysore side) and on the Nadghani Ghat in the Nilgiris.

Mycalesis visala visala Moore.

Both Evans and Talbot record this insect from Kumaon to Assam, which seems to imply that it is, in northern India, confined to the hill country or its immediate neighbourhood. It occurs, however, commonly in Calcutta and probably thence throughout Bengal northwards to the Himalayas.

Mycalesis suavolens tytleri subsp. nov.

Recorded by Talbot only from Sikkim and Bhutan, whence Evans also records *suavolens suavolens*. However, I took a male above Loharkhet and another at Khati, both places on the route to the Pindari Glacier in Kumaon, at about 5,000 and 7,000 ft. respectively.

Brig. Evans confirmed that these were both *suavolens* and presumably ssp. *tytleri*. Kumaon must therefore be added to its habitat.

Mycalesis malsara Moore.

Neither Evans nor Talbot record this species from further south in Burma than Rangoon, but I found a few in February 1939 near Tavoy, S. Burma.

Genus *Lethe* Hubner. It is not, in my experience, correct to say, with Talbot, that the butterflies of this genus fly after sunset, but in the day-time they mostly sit motionless among leaves, flying only a few yards when disturbed. Of course, they do so, but they also fly fairly freely around bushes and trees during the day.

Lethe dura gammiei (Moore).

Both Evans and Talbot record this insect as very rare, but I found it, or rather the males, fairly common in Sikkim, at about 4,000 ft. between Gangtok and Dikchu and from Singhik to Chungthang at between 4,000 and 5,000 ft., in May 1943; in fact, it seemed to be about as common as any other *Lethes* at that season and in those localities. My collector also sent me quite a number of males from the same localities in May and June of the two following years, but only one female. I consider that it would be better described as: males not rare, females very rare.

Lethe rorhia neilgheriensis (Guerin).

Hitherto recorded from Ceylon and S. India to Pachmarhi on the western side. I found a male many years ago, in Calcutta, trying to sample my beer at the 9th hole on the Royal Calcutta Golf Course, but despite much searching over several subsequent years, never discovered another in Bengal.

Lethe margaritae Elwes.

Evans gives Bhutan only as the habitat of this species but both Bingham and Talbot record it from Sikkim also. I can confirm its occurrence in Sikkim, as my collector sent me four specimens (two very torn, but two fairly fresh) taken near Chungthang in the Tista Valley, at about 5,000 ft., in June 1944 and 1945.

Lethe sinorix (Hewitson).

Apparently not recorded previously from west of Sikkim, but I have taken it very rarely near Bhowali in the Naini Tal District of Kumaon at about 6,000 ft. in October.

Lethe yama yama (Moore).

Talbot says that this insect is usually rare. I took a few males in late May, 1943, near Chungthang in the Tista Valley at about 5,000 ft., but, judging by the number (of males; not a single female!) sent by my collector from the same neighbourhood in late May and early June in the following two years, it must be extremely common thereabouts.

Maniola hilaris (Staudinger).

Vide my remarks above, under Baroghil, in connection with Parnassiids. I was lucky enough to find a fair number of this species on the same slopes at about 13,000-13,500 ft. on the 21-23 August 1939. The majority were freshly emerged, while others were very worn and faded. It would seem likely that there are two broods in rapid succession in the summer months there.

Maniola davendra chitralica (Evans).

I captured a few specimens of a *Maniola* in late July and again in early September, 1939, in Dashkin Forest, Astor, on the road to Gilgit. The males were identified for me by Brig. Evans as *davendra chitralica*, hitherto recorded only from Chitral and the Khyber Pass, but the females may be either that subspecies or a race of *M. tenuistigma*, (see below), which I found at the same time and place. Neither Evans nor I could distinguish with any certainty between these females. I also took *davendra chitralica* near the Shandur Pass and in N. Yasin, near Darkot, so that its distribution should include these places.

Maniola tenuistigma ssp.

The specimens I took at Dashkin (*vide* above) and at Doyan, (Astor), on the road to Gilgit, were considered by Brig. Evans to be a slightly differentiated local race of *tenuistigma*, which has not been previously recorded from Astor. That applies to the males; the females we could not distinguish with certainty from my females of *tenuistigma laspura* Evans from Chitral, (or from females of *davendra chitralica*, as stated above.) The main differences, however, seem to be the following: Male upperside forewing, brand slightly wider and more woolly in appearance. Veins 1 to 4 darkened distally. Female rather smaller; upperside forewing rather darker towards the dorsal margin. Male and female underside: ocellus in 5 forewing large. In the female, forewing always a small unpupilled ocellus in 2. Hindwing with prominent grey irroration distally, especially towards the costa, where it may become patchy and obscure the ocellus in 5. A very puzzling pair of butterflies!

Hipparchia persephone enervata (Staudinger).

Neither Evans nor Talbot record this insect from Kashmir, but it does occur there, as I took a few, on the 20-22 July, in Astor, N. Kashmir, at 6,000-8,000 ft.

Hipparchia actaea magna (Evans).

Only recorded by Evans and Talbot from Chitral, (up to 9,000 ft.). Rather surprisingly perhaps, therefore, I took a few in rocky country at about 4,500 ft. near the junction of the river which rises on the north side of the Burzil Pass with the Astor River, and a few more near Dashkin and Doyal in Astor, at between 7,000 and 8,500 ft., all in the second half of July.

Hipparchia hubneri pupillata (Tytler).
,, **moorei moorei** (Evans).
,, **moorei gilgitica** (Tytler).
,, **boloricus chitralica** (Tytler).

Talbot states that '*moorei*, *boloricus* and *regeli* (Alph.) form a puzzling group that requires investigation. It is perhaps doubtful whether *boloricus* and *regeli* are distinct species'. I agree that they are puzzling and would include *boloricus* in this opinion. My limited experience is probably unlikely to throw any useful light on the problem, but I give it for what it is worth. I exclude *regeli* as it does not occur in our region. *Huebneri* then I found very rare and only near the Baroghil Pass, at about 10,000 to 12,000 ft. It was quite possibly out of season; it would appear, from the locality, to be ssp. *pupilata* (Tytler). *H. moorei moorei* I found fairly commonly above the Shandur Lake, at about 12,500 to 13,500 ft., and from near Gazan to the Baroghil Pass at round 10,500 to 12,500 ft., *moorei gilgitica*. I took a few below the Darkot Pass to the south, in N. Yasin (Gilgit), at about 13,000 ft. *H. boloricus chitralica* I found common alongside and slightly above the Shandur Lake and near the Baroghil Pass, at altitudes of from 12,000-13,000 ft. Now *boloricus chitralica* seems fairly easy to separate from the others in this group; it has the pale band on the upperside, in both sexes, nearly white and only just tinged with ochraceous, while in the others the band is generally ochraceous, often turning dull yellow about the ocellus in interspace 5.

It will be noticed from the above observations that all these insects, with the possible exception of *gilgitica*, fly in the same localities; they are also on the wing at the same times, except for *pupilata* perhaps, and had this not been the case, I might well have taken better and longer series of them all. The differences shewn in Evans's and Talbot's keys do not seem constant and, although it is possible that the males can be distinguished by their genitalia, that is scarcely practicable with the females, which are extremely difficult to differentiate visually. Further investigation and longer series for examination are, as Talbot says, most desirable.

Erebia hyagriva (Moore).

Talbot describes this insect as rare, despite the fact that according to MacKinnon (1897), whom he quotes, it is *very common* at Mussoorie in August and September. Peile (1937) is also quoted as saying that it is on the wing only during the rains. I have taken one or two at Dharmsala (Kangra District) in May and found it very common, but in poor condition, at Ranikhet (Kumaon) in late September. I feel therefore that Peile's remarks require modification and that the insect's occurrence should be stated as not rare generally and common in the Garhwal and Kumaon hills.

Ypthima baldus madrasa Evans.

An extreme dry season form occurs in February and March in Mahableshwar, which is very small, with prominent dark fasciae on the underside of the wings, especially the hind wings, distally, and I thought that they might be sufficiently distinct to form a separate race; but I find that they can be matched by other dry season forms from S. India in the collection in the British Museum.

Melanitis leda ismene (Cramer).

On several occasions and over several years, in the monsoon months, sitting after an afternoon round of golf on the Jajmau Course, Cawnpore, on the open grassy patch in front of the club house, near which was a large tamarind tree, I observed in the early dusk what were unmistakably specimens of this insect, rising from near the foot of the tree and flying leisurely upwards in an ever increasing spiral until they were lost to view high in the sky. One would start the flight and another and another would follow in rapid succession, until it became too dark to watch their movements. Judging by their flight and shape, they were all males, and I could see no sign of females flying high above the tree, so that, if these were courting flights, as presumably they were, the females must have been cruising around for some time at a considerable height. I never saw the butterflies descending from their flights,—presumably it would have been too dark to see this phenomenon when it occurred. It would be interesting to know whether others have witnessed similar behaviour on the part of this crepuscular insect and can offer an explanation thereof.

Elymnias hypermnestra undularis (Drury).

Neither Evans nor Talbot record this insect from south of Bengal, though Bingham gives Central India as a locality. I have taken it rather uncommonly in Hyderabad (Deccan), so that it probably extends through Central India down as far as the Deccan.

Elymnias casiphone saueri Distant.

Evans states that this insect is very rare and Talbot says that the female is very scarce and still may not be known from Burma. I took two females, one below Sukli in the Dawna Hills and the other near Mergui, in November 1938 and January 1939 respectively. They are unmistakably *saueri*, being rather like *malelas* female but with the upperside apex ferruginous, (as described by Evans) and the hind wing highly dentate, almost tailed. Strangely enough, however, I took a male below Sukli at the same time, without the 'tail', but definitely *saueri*.

Elymnias peali Wood-Mason.

I took about a dozen specimens of this species, mostly males, chiefly in fair condition but some not worth while keeping, in the forests below the Umran Gate, on the Shillong-Gauhati Road, Khasia Hills, Assam, at about 2,000 ft. in April 1933, whence I believe it has not been previously recorded. Its known range appears, however, to be extending, as Bingham gives it only from Sibsagar and Margherita, Assam, Evans from 'Assam' and Talbot from Assam and N. Burma. Mr. C. B. Antram has informed me that it is widespread in Assam.

Thauria aliris intermedia Crowley.

Both Evans and Talbot say that this insect is very rare (in Burma), but I found it *rather* rare in the jungles near Pathechaung, Toungoo District, at the foot of the Karen Hills, in May 1939. It was almost impossible to obtain one without the tornal angles of the hindwings having been bitten off, presumably by lizards. When they settle, the butterflies sit very close and are difficult to see and to walk up among the rustling fallen leaves which they usually choose as resting places; they also seem to favour awkward spots below shrubs. It is apparently when thus settled that they fall a prey to lizards, escaping without serious damage and torn hindwings. Lizards similarly damage the hindwings of many species in S. Burma—very exasperating to the collector!

Discophora sondaica zal Westwood.

Both Evans and Talbot record this insect only from Sikkim to Burma, yet it is not uncommon in and near Calcutta, especially in bamboo copses, but it can occasionally be found even in the centre of the city, e.g., I took one female in the Bengal Club and two females in a flat in Russell Street.

Discophora timora timora Westwood.

Both Evans and Talbot record this insect from Bengal, but I have never seen it near Calcutta.

Acraea violae (Fabricius).

Evans rightly records this insect from Ceylon and India, while Talbot gives its habitat as Ceylon and Peninsular India. It occurs commonly in Calcutta and Hyderabad (Deccan) and more rarely in Cawnpore, but I never found it in the Punjab. Its distribution would probably be more correctly described as Ceylon and India south and east of the Punjab.

Prothoe franckii angelica Butler.

I only came across two or three examples of this insect, and only in the Dawna Hills and near Tavoy. They all settled on sweet exudations on the trunks of trees, and always upside-down. One would fly rapidly round the tree and suddenly settle on its trunk head downwards; there was no question of it settling in the normal upward position and then turning over. How it achieved this aerobatic feat, I was unable to observe. When settled, it resembled very closely a piece of loose lichen on the bark of the tree. I was unable to ascertain whether its congener, *calydonia belisama* Crowley, behaved in a similar manner, as I only succeeded in catching one, a damaged male, which settled on a piece of durian fruit I had put down as bait, on a path in a forest near Pathechaung, (Toungoo District), and would not budge from its feast even when I lowered my net over it.

Euthalia garuda garuda Moore.

I found this insect quite common in the jungles near Pathechaung and took a number of females, some of which are very different from the normal females. They do not appear to be females of *merta eriphyle* De Niceville and I am hoping that one or more of them may prove to be the females of *mahadeva binghami*, (of which a rather worn male was taken by Mr. W. C. Carrot while we were collecting together for a few days at the beginning of May, 1939), or of *kanda elicius* De Niceville, the females of both of which Evans states are unknown.

Euthalia dunya Doubleday & Hewitson.

I should think that this species is the most difficult of all forest butterflies from our region to catch. It is even more wary than *evelina derma* Kollar. Like that insect, it sits facing the would-be captor on the tip of a leaf, usually within reach, and watches him keenly, waving its antennae meanwhile. It will allow him to strike before flying, but when one thinks one has it and it seems to be actually in the net, it is almost invariably only visible through the bag and on its way rejoicing to an inaccessible perch. I saw a few in the Tavoy District in March 1939 but was only able to capture a pair so elderly and ragged as scarcely to be able to fly.

Liminitis procris undifragus Frühstorfer.

This subspecies is recorded by Evans from S. India, while the race *procris* is said to occur from Dehra Dun to Burma. What exactly that means I have often wondered, but I presume it implies the arc of an imaginary circle covering the foot-hills of the Himalayas stretching between those two places, and not the segment of the circle. If I am correct, the latter race is not recorded from Calcutta, but I have taken it there not uncommonly and have bred it there from larvae found on several occasions. A comparison of these specimens with specimens taken in S. India and Sikkim demonstrates that the Calcutta form is *procris procris*. The favourite food-plant of the larvae appears to be several species of the ?Padam tree, (I am not quite sure of the name, but it has pendulous spheres of florets of a greenish colour).

Neptis columella nilgirica Moore.

Evans records this insect from S. India only, but I have taken a few, in March of several years, in the Botanical Gardens at Sibpur near Calcutta. It should therefore be recorded from Bengal.

Neptis yerburii sikkima Evans.

Its habitat is given by Evans as Sikkim to Assam. Here again I have found the subspecies, in wooded country near Tollygunge, Calcutta, rarely, and there is no doubt that these specimens were *sikkima*. It should be recorded as very rare, from Bengal also.

Kallima inachus huegelii Kollar.

Evans gives its range as Pachmarhi, and Kashmir to Kumaon. I took one or two specimens in poor condition at Taptapani, (E. Ghats,—Berhampur District,) and a fresh specimen was given to me by a friend, which flew into his carriage on a train in the ghat country near Gaya. The distribution of this subspecies is therefore considerably wider than that shewn by Evans, and may perhaps be described as across Central India to Orissa and N. Madras, and Kashmir to Kumaon.

Precis iphita pluviatalis Frühstorfer.

To the habitat of this insect given by Evans, viz.: 'Ceylon; S. and Central India'; should be added Calcutta, where I have taken it rather rarely on several occasions and am satisfied that it is the race *pluviatalis*.

Precis iphita siccata Stich.

Distribution according to Evans 'Kashmir to Kumaon,' but I have come across it very rarely in Cawnpore, U.P., so that it may occur in the United Provinces generally in favourable localities.

Precis iphita iphita Cramer.

This insect is, perhaps, Public Enemy No. 1 to collectors, to whom it can be a positive nuisance, from its habit of sitting on leaves on bushes in favourite beats of butterflies and chasing away all other butterflies which venture near it—usually especially the rarities one is particularly anxious to capture. *Atella phalanta* Drury, is another of the worst offenders in this respect.

Argynnis hyperbius hyperbius Linnaeus.

Recorded by Evans from Mt. Abu, Baluchistan, Chitral to N. Burma. I have taken this insect in Amritsar (Punjab), Cawnpore (U.P.), where I also bred it from larvae found on pansies in my garden. Also Thandaung (Karen Hills) which are really situated in Lower Burma. The range of the subspecies should therefore be extended to cover the Punjab, the United Provinces and the northerly parts of Lower Burma.

Dodona henrici longicaudata De Niceville.

I was fortunate enough to discover this insect, which is described as very rare, in fair numbers, more or less freshly emerged, below the Umran Gate on the Gauhati-Shillong Road, at about 2,000 ft. in March 1933. Among them were a few females, hitherto unknown. They were all, of course, Dry Season Forms, but I subsequently received one or two wet season males from the same locality, taken in August, which are darker and more heavily marked. I append a description of the D.S.F. form of the female:—

Resembles the male, but the fore wings are broader and the apex blunter, the termen being straight or even slightly convex, whereas in the male it is normally slightly concave. The black markings are greatly reduced, the basal markings on both wings being light greyish instead of dark brown, while the greenish-white discal band is very broad and the whitish markings on the postdiscal half of the wings are much enlarged and prominent, with white sub-marginal lines from tornus to vein 2 on the forewing and more or less complete on the hindwing. Underside similar to that of the male, but with the whitish markings enlarged and prominent. The tail is longer than in the male and the black at the extremity of the lobe is crowned with the ground colour.

I took one female in which the whole of the upperside is greenish white, except for a slight grey dusting basally and, on the forewing, a black spot on the costa just beyond the cell, a postdiscal fascia from the costa to vein 4 and a black margin from the costa, decreasing in width gradually, to the tornus. On the hindwing, the black markings are almost confined to the anteciliary fine lines. In fact, this female shows a close approach to the dry season form of the female *henrici deodata* Hewitson, from Burma.

Abisara echerius suffusa Moore.

I have not seen any account of crepuscular habits of this butterfly, so that, in Pachmarhi in early August 1945, as I was returning to my hotel after an afternoon's collecting, (when the rain permitted), I was surprised to see several specimens, of both sexes, flying round some bushes in the gathering dusk. I took one or two, to make sure I was not mistaken in my identification; I watched them gambolling around until it became so dark that I could only see an occasional flirt of their wings. It would be interesting to know whether such crepuscular flight has been seen by other collectors.

Gerydus boisduvali assamensis Doherty.

Collecting one October afternoon in the compound of a disused house off the Kathgodam—Naini Tal road at about 4,000 ft., (now, I believe, used as an apiary), I was intrigued to find a few of these insects flying around with their characteristic falling and rising, Geometer moth-like flight. There is no discernible difference between these specimens and those I took in Sikkim, Assam and Burma, and Brig. Evans, to whom I showed them at the British Museum, was not surprised to hear that the subspecies had turned up in Kumaon. He records it only from Sikkim to Burma.

Everes parrhasius parrhasius Fabricius.

Evans gives its habitat as Ceylon and S. India. I have found it in Hyderabad (Deccan) and very rarely in Cawnpore, U.P. It looks therefore as if it occurred throughout India as far as the United Provinces, but not, apparently east of them, as I have not come across it in Calcutta or Behar.

Megisba malaya thwaitesi Moore.

Evans records this subspecies as occurring in Bengal. This is the tailless form, but the few I have taken in Calcutta are all tailed, and are therefore race *sikkima*, which Evans records from Kumaon to Burma. The habitats of these two races seem to require revising in the light of the above.

Lycaenopsis ceyx cerima Corbet.

I took three specimens of a small, bright blue *Lycaenopsis*, one near Tavoy and two near Mergui, in S. Burma, early in 1939, which I could not ascribe to any of the members of this genus described by Evans. I therefore took them up to him for identification and after considerable search through the genus in the main collection in the British Museum, we discovered one rather battered specimen, taken some years ago by Brig. Evans himself in Burma, which agreed superficially with my specimens; it was a subspecies of *ceyx*. *L. ceyx tanarata* Corbet occurs very rarely in Malaya and Evans's specimen was the only previous one taken in Burma. This and mine were later named *ceyx cerima* by Corbet. Subsequently Sir Keith Cantlie received a specimen from Assam, which was identified as belonging to the same subspecies, and the identification of Evans's, my and Cantlie's specimens as *ceyx cerima* was confirmed by an examination of the genitalia. Cantlie's specimen was collected by Dr. T. Norman, of Seleng Tea Estate, who described it on p. 515 of the *JBNHS*, Vol. 51 (2) April 1953, under his notes on the Lepidoptera of Assam. But, as I had already prepared a description of the male, I append it here.

Shape of the wings normal, with the apex of the forewing rather rounded. Upperside glistening caerulean blue with black borders, those on the forewing decreasing in width from about 2 mm. at the apex to a thread at the tornus, and those on the hindwing a thread with a very slight broadening at the apex. Slightly paler, especially when viewed sideways, beyond the cell in interspaces 2 and 3 of the forewing and with long white patches distally in interspaces 6 and 7, extending slightly into 5, on the hindwing.

Underside very pale grey, all the spots black, those on the forewing being perhaps streaks rather than round spots, set slightly obliquely, nearer the margin than the end of the cell, that in 6 slightly and that in 7 strongly shifted inwards. Hindwing with no spot in the extreme base of interspace 7 or near the base in 1 b.; markings prominent, the rounded spot in 7 larger than the rest, the discal spots in 4 and 5 very faint or missing, the discal series placed rather nearer to the end of the cell than the margin.

Ceyx cerima must now be included in the genus *Lycaenopsis*, among the butterflies of India and Burma, in the *Haraldus* group, after *chelaka lenya*, nov., with Assam and lower Burma as its distribution and very rare as its occurrence.

I presented one of my specimens to the British Museum.

Lycaenopsis lavendularis limbata Moore.

Evans gives the habitat of this insect as S. India to Bengal, but I have never come across it in Calcutta.

I accept the revision of the names, etc., of certain species and subspecies of this genus made by Brig. Evans recently and published as a Miscellaneous Note in the Society's journal, August 1953.

I was, however, doubtful about his sinking of *lilacea* Hampson from S. India in *puspa* Frühstorfer, as I have specimens of typical *puspa gisca* Frühstorfer which I took in the wet season in the Nilgiris, and of *lilacea,* which I took during the monsoon at the foot of the Gudalur Ghat, on the Mysore Road, in the same range of hills. These latter agree with Evans's key, in that the inner edges of the spots on the underside of the forewing in interspaces 2 to 5 lie on an even arc; their general appearance is also very different from that of the *puspa* specimens. Evans has, however, recently assured me that he only decided on this sinking after it was established by examination of the genitalia that the two are conspecific. It seems likely, therefore, that my, and probably others', supposed specimens of *lilacea* are extreme wet season forms from low altitudes in areas of heavy monsoon rainfall.

I entirely agree with his objection to the modern tendency to split up easily recognised natural groups into numbers of genera. Talbot also, I observe, prefers retention of reasonably large genera for homogeneous species, dividing them, where desirable, into species groups, therein following Evans.

Lycaenopsis musina musinoides Swinhoe.

I have one specimen taken in the Tista Valley, Sikkim, which can, I believe, only be this subspecies. The arrangement of the spots on the underside tallies with Evans's description and it has the peculiar, elongated, triangular androconia, which have, however, 14 to 17, and not 13, ribs.

Lycaenopsis argiolus sikkima Moore and **jynteana** De Niceville.

Evans's Miscellaneous Note above quoted treats *sikkima* as a synonym of *argiolus jynteana*, with which determination I agree.

Polyommatus loewii sanoga Evans.

I took a female in poor condition near Doyan, Astor, which Evans identified for me as this subspecies. He only records it from Chitral, but it should now be recorded as occurring in Gilgit also.

Polyommatus orbitulus

I took series of this species on the Rajdiangan Pass, north of Tragbal, Kashmir, at nearly 12,000 ft., on the Burzil Pass, N. Kashmir at about 13,500-14,500 ft., and also in the Bringi Valley and on the Diniaspur Pass, from 11,000 to 14,000 ft., SE. Kashmir, in 1939. I took a number of these to the British Museum and Brig. Evans kindly helped in their identification. The series from the Himalayas in the British Museum are not well arranged and have not been dealt with or rearranged for years. It seemed, however—after careful comparison with the material available there—most probable that the Rajdiangan and Burzil specimens were race *jaloka* Moore, with which they appeared more or less to agree, although they shewed some affinity with the Chitral race *walli* Evans, and that the SE. Kashmir specimens were race *ellisi* De Niceville, although, in his 'Identification', Evans records this race from Pangi, as they have, like that subspecies, white spots below. The Indian races of this species therefore seem to require revision and a regrouping of their habitats.

Polyommatus icarus chitralensis Swinhoe.

This insect is recorded by Evans only from Chitral but I found it common along my route to the Baroghil Pass, commencing at Bunji, at about 4,000 ft., in the dry, hot, Indus Valley, and again at Gilgit, at 5,000 ft. and, in suitable localities thence to the Shandur Pass, at *ca.* 12,000 ft. and slightly over, and to the Baroghil Pass, in Chitral, at about 12,000 ft. My specimens from the higher localities appear to be generally larger, with more pointed forewings and much paler below, the spots tending to obsolescence. Brig. Evans, however, assured that my specimens from the Gilgit Wazarat were undoubtedly *icarus chitralensis*. Gilgit must therefore be added to the distribution of the subspecies.

Polyommatus poseidion florenciae Tytler.

This is listed by Evans as very rare, and he told me that very little is known about the subspecies. It may therefore be of interest to know that I took a few near Gazan in NE. Chitral, in the second half of August, 1939, at about 11,000 ft. I also came across one or two more in ravine country 3 or 4 miles short of the Baroghil Pass, at about 11,000 ft., a week or so later. Unfortunately they were all more or less worn, or I could have taken and kept a fair number more. It would appear that they emerge towards the beginning of August, in those localities.

Euchrysops contracta contracta Butler.

I found this insect common in Cawnpore, where it has broods in the spring, the rainy season and the late autumn and early winter. The U.P. should therefore be added to its recorded distribution, viz:—S. India to Sind; Baluchistan; N.W.F.P., and Punjab.

Euchrysops pandava pandava Horsfield.

In Bengal, at any rate, this insect occurs in 4 seasonal forms. The wet season form is large and dark, with all the markings beneath coarse and prominent. The autumn form is small and pale below with the spots nearly of the ground colour. The winter form has a broad dark discal band beneath, the females having the blue on the upperside very extensive, in some cases only narrowly bordered terminally with black. The spring form is very like the autumn form, save that the spots on the underside are a little more conspicuous and darker than the ground colour generally.

Lycaenesthes emolus emolus Godart.

Evans records this insect only from S. India and Sikkim to Burma, but I found it fairly common in Calcutta and it probably occurs thence northwards through Bengal to Sikkim.

Lycaenesthes lycaenina lycaenina Felder.

The distribution given by Evans is Ceylon; S. India; Orissa. I have taken it very rarely near Calcutta, but only—to the best of my recollection—in the Botanical Gardens, Sibpur.

Orthomiella pontis pontis Elwes.

I have only come across this insect between Singhik and Chungthang in the Tista Valley, Sikkim, at about 4,000-5,000 ft. It seems to enjoy settling on wet, muddy patches on the 'kutcha' bridges over mountain torrents, (Could this predilection have influenced the choice of its specific name?) and on rocks bordering the torrents, where it gets sprinkled by the spray.

Nacaduba noreia noreia Felder.

I took one or two males in Maymyo, Upper Burma, and also at mile 75 on the Tavoy-Ye Road; this is just south of the border between the Tavoy and Moulmein Districts of S. Burma. S. Burma should therefore, be included in its habitat. In addition to the clues given in Evans's key, the following points of difference may help to distinguish the males of this subspecies from the males of *L. dubiosa indica* Evans and *sivoka* Evans. Forewing longer proportionally to the hindwing; termen straighter and apex more pointed. Dark borders on the upperside of both wings broader and more conspicuous. Underside more uniform grey-brown and the spot in interspace 2 of the hindwing smaller. A sturdier insect generally.

Lycaena kasyapa var. zariaspa Moore.

I have only taken this 'variety' at about 9,000 ft. and upwards, and the typical form from 6,000-8,000 ft. It seems possible, accordingly, that *zariaspa* is really a high altitude subspecies of *kasyapa* and not merely a variety or form of that insect. It would be interesting to know whether the experience in that respect of other recent collectors agrees with mine and whether the evidence for the treatment of the two as valid subspecies is now sufficient.

Heliophorus brahma mogoka subsp. nov.

I have a couple of males of this insect from Kalaw, Southern Shan States. The habitat should therefore be extended to include these states.

Heliophorus androcles moorei Hewitson.

Presumably Evans, by the words 'Sikkim, Chumbi.' (note the comma and fullstop), in his distribution of this subspecies, intends to imply that it is only found in the Chumbi Valley in Sikkim, (as far as Sikkim is concerned), but, apart from the fact that that valley lies in SE. Tibet, the race occurs fairly commonly in the Tista Valley in Sikkim, at about 4,000-5,000 ft. Sevastopoulo informed me that he had taken it not uncommonly in the Darjeeling District. Its habitat should therefore be amended accordingly.

Strymon mackwoodi Evans.

Evans records this species from Manipur and the N. Shan States only, but I have a small series from Kalaw, in the S. Shan States, where I was advised that it is not very scarce. Its habitat should be extended accordingly.

Thecla vittata Tytler.

My collector sent me three males from near Chungthang in Sikkim, at about 5,500 ft., which I could not match with *duma duma* Hewitson, which appeared to be the only subspecies of the genus like mine recorded from Sikkim. I therefore took my specimens to the British Museum and shewed them to Brig. Evans. We found that they seemed nearest to *vittata* Tytler. Brig. Evans extracted the genitalia from one of my specimens and one of the Museum specimens, and after careful microscopical examination, pronounced them to be identical. It therefore follows that *vittata* must be recorded from Sikkim also, as well as from Manipur and the Naga Hills. The only superficial differences we could see between the two specimens was the fact that in mine the basal line in interspace 7 did not cross the cell, as in Evans's key, but, as he says there, the cell portion may be obsolete.

Chaetoprocta odata Hewitson.

In my specimens from Kumaon, taken in the second half of May, the several bands on the underside are filled in with yellowish-brown and are equally prominent, whereas those taken by me in N. Kashmir, (Astor, Gilgit, etc.,) in July have only the post-discal band underside forewing so filled in and prominent. Also the purple colour on the upperside is paler and more greyish in the Kumaon specimens. These differences appear to be seasonal, a spring or dry-season form in May and a wet-season form, (although the rainfall in N. Kashmir is rather scanty,) or a second brood, in July. Incidentally, I had never found this insect common until I came across a walnut tree at the southern approach to Doiyan, (Astor), at about 8,000 ft., literally defoliated by its larvae and the newly emerged butterflies absolutely swarming all over the tree and the surrounding grass ! [*vide* Vol. 47 (4) p. 571].

Iraota timoleon timoleon Stoll.

Although the females are normally purple with broad borders, on both fore and hind wings, on the upperside, I have a female taken in Calcutta, where this insect occurs rarely, especially in the neighbourhood of Banyan trees, with the purple on the forewing very much restricted and the hindwing plain brownish-black.

Amblypodia ? agesilaus Staudinger.

I took a butterfly below the Sukli rest-house, in the Dawna Hills, S. Burma, in November 1938, which seems to belong to the *Epimuta* group, as it has the discal spots in 5, 6 and 7, on the underside of the hindwing with their centres in line and more or less rounded, and has no well-defined basal dark area below the cell on the underside of the forewing. I shewed this specimen to Brig. Evans at the British Museum, but, although we searched all through the *Amblypodias* in the collection there and his book of illustrations of all the known *Amblypodias*, we could find nothing like it. Brig. Evans considered it to be an entirely new species, but opined that, after Corbet's death, there was none at the British Museum competent to determine what the insect actually is. I append a description:—

'Tailless. Upperside: a rather soft heliotrope blue, with a slight sheen in a side light. Forewing, black border 1 mm. at tornus expanding to 2 mm. at vein 1 and increasing regularly to 3 mm. at the apex, continuing along the costa for about half the length of the wing. Hindwing, border about 1 mm., with a fine anteciliary pale blue line from the tornus to vein 3.

Underside: Purple brown, with large, separated, white-circled spots, the brown colour paler on the lower part of the forewing. Forewing discal band of round separate spots completely broken at vein 4, the inner edge of the spot in 4 joining the outer edge of the spot in 3, the band not continued below vein 1. Hindwing, the shape of the inner discal spots very irregular, the spots in 5, 6 and 7 in echelon, as usual, the inner edge of the spot in 5 meeting the outer edge of the spot in 4, the spots rounded and separated, not continued below vein 1. A double wavy line, becoming angled inwardly towards its upper end, distal to the discal band, bordered exteriorly in 1 b and 1 by light blue scales.'

Amblypodia adatha regia Evans.

Recorded by Evans from Mergui only but I took a pair in Tavoy. Its range may therefore extend from Tavoy to S. Burma.

Amblypodia centaurus pirithous Moore.

Recorded by Evans from Kumaon to Assam, with occurrence 'not rare'. I took what I first thought to be a dull and worn specimen of *A. amantes amantes* Hewitson, which proved on examination to be *A. centaurus pirithous* Moore, surely an unusual habitat for an insect which is normally confined to the foot-hills of the Himalayas and Assam. This was the only specimen of this insect which I found near Calcutta, but at times it is common in the plains of N. Bengal adjoining the Himalayas,—for instance along the road from Siliguri to the Tista Valley, in the outer parts of which it sometimes swarms in such numbers as to be a positive nuisance. I have also taken it on Senchal near Darjeeling at about 8,000 ft., rather to my disappointment, as when I saw a few large *Amblypodias* flying around a tree there, at that altitude, I expected them to be something new to me and rare!

Amblypodia adriana De Niceville.

Evans gives its habitat as Sikkim to Shan States, but I took a rather worn male on a stream bed about 5 miles from Kathgodam along the Naini Tal road, in Kumaon, in March 1932. Its range should therefore be extended to include Kumaon.

Amblypodia areste arestina Evans.

To the habitat of this insect given by Evans, viz., N. and S. Shan States, must be added Karen Hills, as I took a female in Thandaung in those hills, at about 4,000 ft., in May 1939.

Surendra amisena Hewitson.

Its distribution is given by Evans as Tavoy to S. Burma, but I took it in the Dawna Range, almost due east of Moulmein, in April 1939. S. Burma, would therefore be a better description of its distribution.

Spindasis lohita lazularia Moore.

This butterfly occurs very rarely in Calcutta, so that its distribution should be amended from 'Ceylon: S. India,' as shewn by Evans, to 'Ceylon: S. India and lower Bengal.' Incidentally, I observe that Evans, in his introduction to the 2nd edition of his 'Identification', on page 22, states that India may be regarded as falling into certain divisions, one of which is S. India. This, he says, embraces the entire Madras and Bombay Presidencies and extends throughout the plains of India. I seem to remember, also, that in the first edition, he said that Bengal seemed in some respects to belong to the S. Indian region. With the latter remark I agree generally, especially as far as lower Bengal is concerned but it is difficult for the ordinary man to envisage the United Provinces and the Punjab, for instance, as part of S. India, whatever their geological formation. I therefore prefer to regard S. India, from the point of view of the distribution of butterflies, as roughly the equivalent of Peninsular India, or as running approximately from a line from Cutch to the northern tip of Orissa, southwards. As regards lower Bengal, it will be observed from the foregoing that a fair number of the local butterflies belong to the S. Indian races, but there are, also, a few, which seem to have crept down from the Himalayan foot-hills, belonging to the NE. Indian subspecies.

Zesius chrysomallus Hübner.

Habitat shewn by Evans as Ceylon; S. India to Orissa. It occurs also rarely in and near Calcutta, where I have taken a few, all but one being females, mostly in the Botanical Gardens, Sibpur. My collecting visits to these gardens, were almost entirely confined to Sunday and holiday mornings, but the male was captured one afternoon. Does it fly only in the afternoons?

Pratapa blanka argentea Aurivillius.

Evans gives its habitat as Sikkim to Dawnas. I took one male on Tavoy Hill in February 1939; its range is therefore probably Sikkim to Tavoy.

Pratapa deva deva Moore.

Evans gives the distribution of this insect as Ceylon; S. India to C.P. To this must be added Calcutta, as I have taken it very rarely there, but only in December and January.

Pratapa deva lila Moore.

This subspecies I took in Tavoy; its habitat should therefore be revised from 'Mussoorie to Dawnas' to 'Mussoorie to Tavoy'.

Pratapa cleobis Godart.

This species also occurs in Calcutta, where I have found it very rare in the cold weather. Evans gives the distribution as S. India. Dun to Dawnas, which presumably does not include lower Bengal.

Charana jalindra indra Moore.

I have taken this insect very rarely in Calcutta, whence Evans does not record its occurrence. According to him, it is found only in Orissa and Sikkim to the Dawnas.

Charana cepheis De Niceville.

I took one male and one female, at Umran, on the Gauhati-Shillong Road, in March 1933, at about 2,000 ft., which are apparently this species. They are, of course, dry season forms, but they differ considerably, especially on the undersides, from Evans's description, (which may be based on wet season forms). The ground colour on the underside in the male is pale yellow and in the female greyish. The discal band is ferruginous-brown, very much narrower and more macular than in *mandarinus* Hewitson, and beyond that the marginal area is paler, with a subterminal similar very narrow band, (scarcely visible in the male) and some faint marginal markings. On the upperside, the female has the discal area slightly paler with a bluish tinge outwardly, on the forewing, and the tornal 'white' area on the hindwing is dull blue, (as in the male, but paler).

Horaga amethystus H. H. Druce.

In Pataw Island, opposite Mergui, in early 1939, I took a pair of *Horagas*, which I could not match with any of those listed by Evans. I therefore took the specimens to him for identification and, by searching through the genus in the collection at the British Museum, we discovered that they were undoubtedly *amethystus* and in all probability race *purpurascens* Corbet, hitherto only recorded very rarely from Malaya. In the British Museum were only one male, the type, and three females, one of which is the paratype. I append a description:

Male. Sex mark similar to that of *onyx* Moore and *moulmeina* Moore, but inconspicuous. Upperside deep violet purple with narrow, even, black borders on both wings, the usual white patch on the forewing minute. Female. Upperside similar, the black border and increasing to the apex of the forewing and reaching inwardly the white patch which is larger than in the male. Underside, male and female, uniform dull ochreous, with the usual white fasciae, which are very narrow on both wings and the usual irroration and metallic green markings tornally on the hindwing, where these markings inwardly border the white fascia.

This subspecies should therefore be included in the butterflies of our region, as occurring at Mergui in S. Burma, very rarely.

Chliaria othona Hewitson.

Distribution as given by Evans 'S. India, Dun to Burma'. It occurs however, rarely near Calcutta, where I have found a few, chiefly in the Botanical Gardens at Sibpur, on and around the *Kleinhovia hospita* trees. I suspect that this tree may supply the food-plant of the species, and often examined the leaves, flowers and fruit of the tree but never succeeded in finding any larvae which might have been *othona* caterpillars.

Deudorix epijarbas epijarbas Moore.

Evans records its habitat as Ceylon; S. India to Orissa. I have found it very rare in Calcutta and can see very little difference between the Calcutta specimens and specimens from Kumaon and Simla District, but, as the subspecies *epijarbas* is recorded from as near as Orissa, I consider it probable that the Calcutta forms are race *epijarbas*. More material is probably required to determine this point, however.

Rapala abnormis Elwes.

Evans gives its distribution as Karens to S. Burma, rare, and says that the female is unknown; there was no female of this species in the collection at the British Museum, in August 1950, when I asked Brig. Evans whether his statement still held. I received a female, however, in a parcel of butterflies collected by Mr. W. S. Wood, of the Widnes tin mine, about 40 miles nearly due east of Tavoy, S. Burma, in November 1939. I append a description:

Female. Closely resembles the male, but the upperside is not, as in the male, shot with brilliant purplish-blue. Underside similar to that of the male. The wings are rather broader, especially the forewing, and less acuminate. Upperside dull purplish-blue, semi-transparent, with a steely-blue suffusion proximally in certain lights.

Rapala varuna lazulina Moore.

Recorded only from Ceylon and S. India. I have, however, taken it very rarely in Calcutta; possibly it is not actually so scarce, but is inclined to be overlooked, owing to its similarity, especially on the wing, to *schistacea* Moore, with which it flies. The females of the two species are extremely difficult to distinguish with certainty. One or two of the few specimens of *varuna* I took in Calcutta seem to approximate to subspecies *orseis* Hewitson, recorded from Sikkim to Burma. But, on the whole, I consider the Calcutta race is *lazulina*.

Rapala pheretimus petosiris Hewitson.

Habitat Sikkim to Burma, according to Evans, but I have taken it fairly commonly in the Botanical Gardens at Sibpur, near Calcutta, where it flies in April. I did not find a wet-season form there.

Rapala dieneces dieneces Hewitson.

On the other hand, I have not come across this insect in Calcutta, although Evans records it from Bengal.

Rapala melampus Cramer.

Evans gives the distribution as Ceylon; S. India to Orissa; Murree to Kumaon. But it would probably be nearer the actuality to shew it as 'Ceylon; India to Murree and Kumaon,' as I have taken it very rarely in Calcutta and less uncommonly in Amritsar and Cawnpore.

BRAMBLE LEA, MARESFIELD PARK, SUSSEX,
September 9, 1954.

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COMPARATIVE OBSERVATIONS ON THE PLACENTA AND FOETAL NUTRITION IN ELASMOBRANCHS AND MAMMALS

BY

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(*With two plates*)

CONTENTS

1. INTRODUCTION 831
2. TABLE SHOWING THE NATURE OF PLACENTAE IN BOMBAY ELASMOBRANCHS ... 832
3. A COMPARATIVE ACCOUNT OF THE SELACHIAN AND MAMMALIAN PLACENTAE ... 832
4. EMBRYONIC ALIMENTATION IN ELASMOBRANCHS 835
5. SUMMARY 839
6. REFERENCES 840

INTRODUCTION

Accounts of the anatomy and histology of the placenta in elasmobranchs are scarcely comprehensive and certainly too scattered to permit of a clear and comprehensive picture of the complex nutritional processes that characterise the foetal life of this group of fishes. The present paper is a generalised discussion of the phenomenon of placentation in elasmobranchs, based principally on the author's study of over a dozen placental forms in Bombay, the detailed observations on which have been presented before in a series of papers published elsewhere (*vide* References).

The subject matter has been presented in the form of a comparison with the mammalian placentae, the concept of comparison being the most natural one while dealing with an organ performing the same essential function in two classes of vertebrates so widely separated in the ladder of evolution. In the light of this comparison an attempt is made to interpret the mechanism of action of the yolk-sac and the yolk-sac placenta, the early or late formation of which among elasmobranchs seems to be influenced by the initial quantity of yolk in the mature ovum.

Finally, a discussion on the influence of the appendicula on embryonic alimentation and their possible relationship to the mature ovum and the placenta has also been added, since these structures play no less important a role in the foetal nutrition in some of the species of this group.

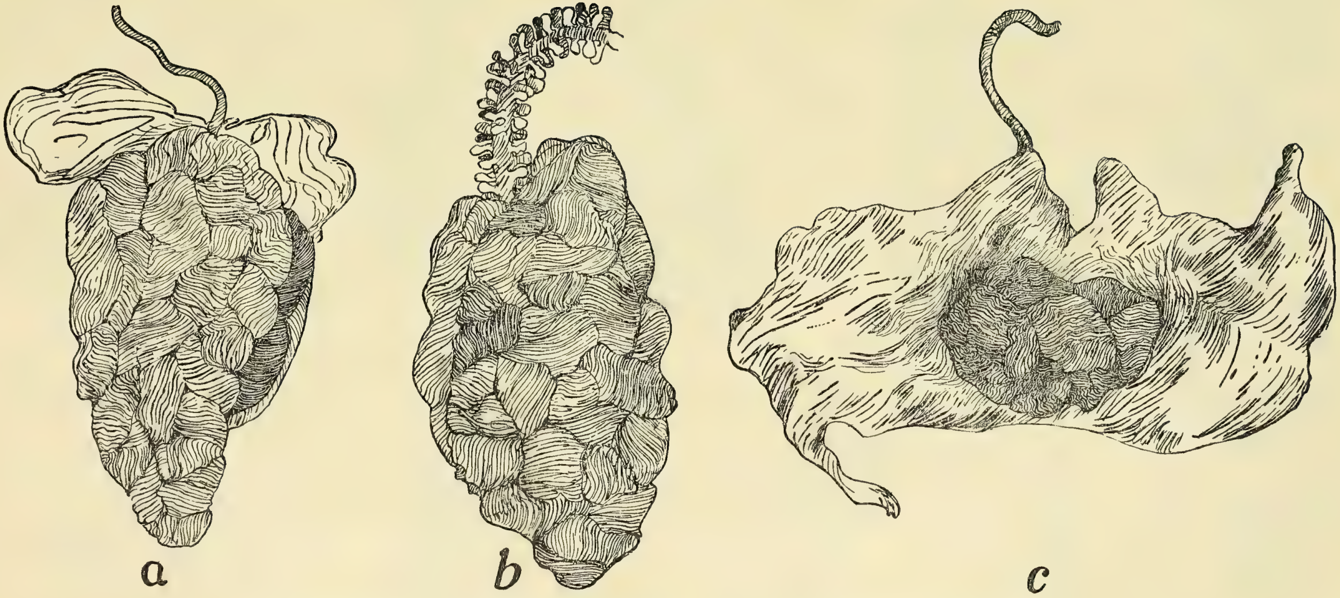
TABLE SHOWING THE NATURE OF PLACENTAE AND APPENDICULA IN SOME OF THE ELASMOBRANCHS OF THE BOMBAY WATERS

Name of species	Nature of a placenta		Nature of appendicula
	Morphological	Histological	
1. *Scoliodon sorrakowah*	Simple, contact type.	Haemo-epithelio-chorial.	Very long, prominent strap-shaped structures.
2. *Scoliodon palasorrah*	Firm, interdigitating type with folding over the entire face-Entire.	Epithelio-chorial.	Delicate, thread-like and much branched.
3. *Scoliodon walbeehmi*...	,,	,,	,,
4. *Scoliodon acutus* ...	,,	,,	Short, irregular outpushings of the placental cord sheath.
5. *Aprionodon acutidens*	,,	,,	No appendicula.
6. *Hypoprion macloti* ...	,,	,,	,,
7. *Carcharinus limbatus*	,,	,,	,,
8. *C. melanopterus* ...	Firm, inter-digitating type with folding only basally—Discoid.	,,	,,
9. *C. sorrah* ...	,,	,,	,,
10. *C. temminckii* ...	,,	,,	,,
11. *C. menisorrah* ...	Entire	,,	,,
12. *Hemigaleus balfouri*...	,,	,,	Rather short, delicate and much-branched threads.
13. *Hemipristis elongatus*	,,	,,	Broad, vascular frills of the placental cord sheath.
14. *Sphyrna blochii* ...	,,	,,	Gelatinous, lobulated structures sometimes bi-lobed and tri-lobed.
15. *S. zygaena* ...	,,	,,	Flattened, obovate leaf-like flaps of the placental cord sheath.

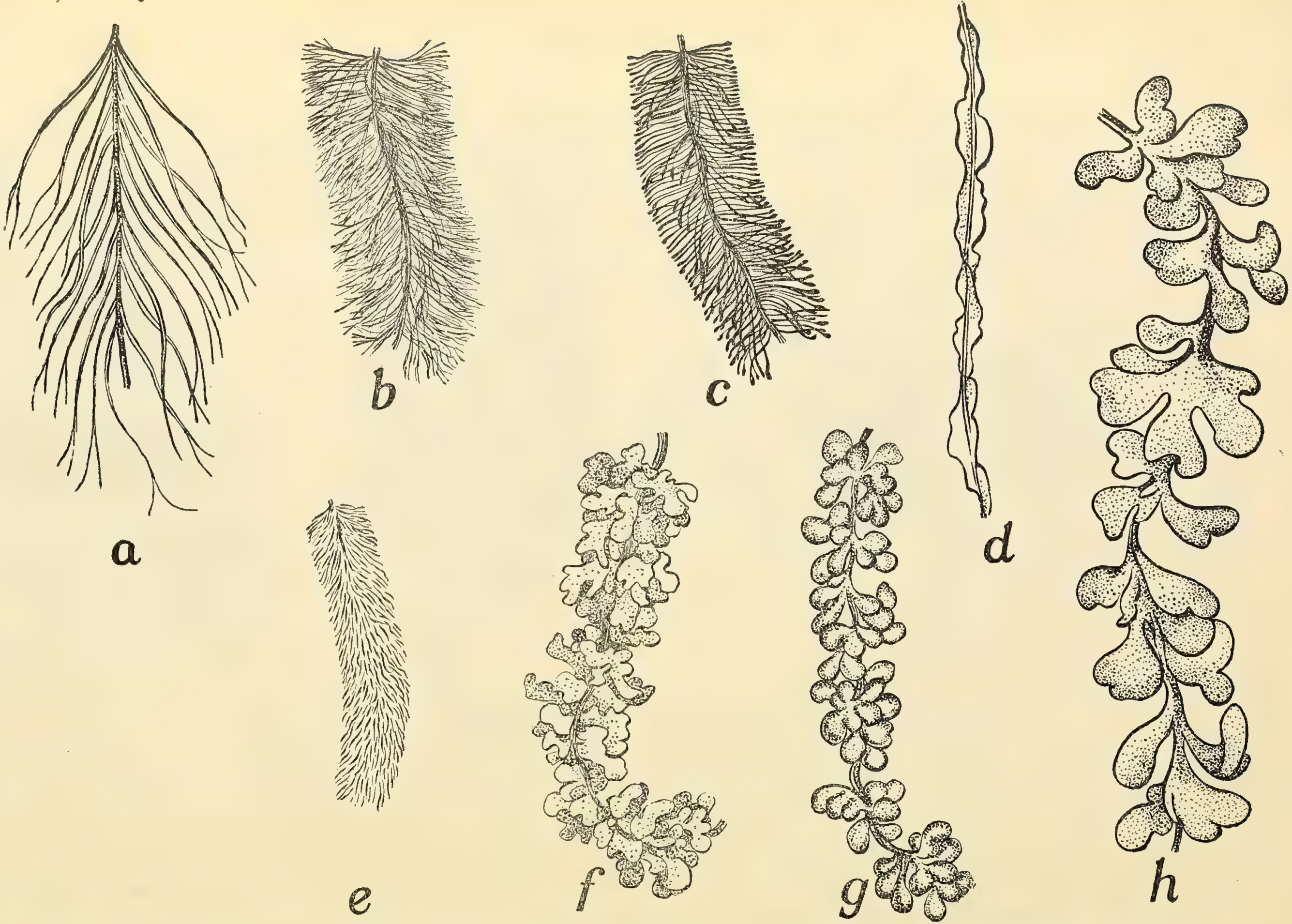
A COMPARATIVE ACCOUNT OF SELACHIAN AND MAMMALIAN PLACENTAE

1. The placenta in elasmobranchs is a simple yolk-sac placenta as distinguished from the yolk-sac placenta found in some of the primitive mammals such as Opposum and Dasyurus, in which this organ is, in part at least, composed of the foetal membranes—amnion and chorion, characteristic of the amniota. The selachian yolk-sac placenta is thus, anatomically not comparable either to the allanto-chorionic or to the truly chorionic placenta of the higher mammals.

2. In all the placental elasmobranchs examined by me, with the solitary exception of *Scoliodon sorrakowah* (*vide* Table), the wall of the yolk-sac becomes excessively folded with the gradual consumption



Foetal placentae in Bombay elasmobranchs. (*a*) entire placenta (*Hypoprion macloti*); (*b*) entire placenta (*Sphyrna blochii*); (*c*) discoid placenta (*Carcharinus temminckki*).



Appendicula in Bombay elasmobranchs. (a) *Scoliodon sorrakowah*; (b) *S. palasorrah*; (c) *S. walbeehmi*; (d) *S. acutus*; (e) *Hemigaleus balfouri*; (f) *Hemipristis elongatus*; (g) *Sphyrna blochii*; (h) *S. zygaena*.

of the yolk and the folds are highly vascularised by the placental vessels. The wrinkled and frayed yolk-sac folds fit firmly on the furrows between the vascular villi of the maternal trophonema, which constitutes the maternal portion of the placenta. Both the foetal and the maternal parts are held together by a firm inter-digitating arrangement which represents the fourth and final stage of contact in Ercolani's (as quoted from Needham, 1931) classification of the selachian placentae.

A similar inter-digitating contact between the foetal and maternal tissues also exists in placenta of Ungulates.

3. Two morphological varieties of the selachian foetal placenta described above may be said to exist among the various elasmobranchs examined by me. They are: (i) the discoid placenta (Text-fig. 1, *c*) and (ii) the entire placenta (Text-fig. 1, *a* & *b*). This nomenclature is adopted purely on the basis of the extent of folding undergone by the wall of the original yolk-sac. The folding in the 'discoid' placenta is confined only to the basal region of the yolk-sac where it forms a thick and spongy mass, roofed over by a free, unwrinkled proximal portion of the yolk-sac wall, while the process of wrinkling in the 'entire' placenta extends all over the yolk-sac wall with very little or no free portion at all.

In mammals, the extent of the chorionic villi on the placenta forms the basis of placental classification, there being such morphological varieties as diffuse, cotyledonary, zonary and discoid.

4. In the inter-digitating type of the selachian placenta described above, the foetal and the maternal tissues, at birth, are merely withdrawn from each other like fingers from a glove. There is no shedding of the maternal tissue. These may, therefore, be described as corresponding to the adeciduate placentae of the Ungulata.

5. The secretion of a nutritive lymphoid exudate from the uterine mucous membrane in primitive mammals and of the 'uterine milk' in ruminants and their absorption by the foetal tissue are, in a way, comparable to the nutritive uterine secretions in elasmobranchs in general and their absorption by such embryonic structures as yolk-sacs, branchial filaments, appendicula and the embryonic body generally. These latter secretions have been designated by Needham (1942) as 'histotrophe'. As in mammals, histotrophe has been observed by me in our elasmobranchs to be more copious when a placenta is either absent, as in some of the viviparous Batoids such as *Dasyatis*, *Pteroplatea*, *Aetobatus*, *Mobula*, etc. (aplacental viviparity) or is present but is poor in functional efficiency as in *S. sorrakowah*.

It would be relevant to refer at this stage to Ranzi's (as quoted by Needham, 1942) work on foetal nutrition in some of the European elasmobranchs. He made quantitative determinations of the embryonic development in oviparous (*Scyllium canicula*), ovo-viviparous[1] (*Trygon*, *Myliobatis*, *Acanthias*, *Centrophorus* etc.) and viviparous forms and his work tends to show that the histotrophic form of alimentation is even more efficient than the placental form as evidenced in *Mustelus laevis*, the type specimen of selachian placental viviparity (epithelio-chorial placenta). Ranzi has, however, pointed out that the absorption of yolk and the speed of embryonic development are greater in the placental *M. laevis* than in the non-placental, ovo-viviparous forms *M. vulgaris* and *M. antarcticus*.

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[1] Ranzi has used the term (ovo-viviparous) to denote non-placental viviparous elasmobranchs, and the term (viviparous) to denote placental forms.

6. The histology of the placenta in *Scoliodon palasorrah* which may be regarded as the type of the discoid and entire placentae referred to above, has been admirably described by Mahadevan (1940). According to her a number of tissue layers intervene between the foetal and the maternal blood streams. These are, from the maternal to the foetal side, (i) endothelium of the maternal blood capillaries in the villi of the trophonema, (ii) the uterine mesoblast, (iii) uterine epithelium covering the villi, (iv) yolk-sac ectoderm, (v) yolk-sac mesoderm and (vi) endothelium of the yolk-sac blood-capillaries.[1] In the most advanced stages of the placenta, the various layers show a tendency to attenuation, so as to bring about a closer apposition of the maternal and foetal blood-streams. On a histological basis of tissue relationship, the above type of placenta in mammals is described by Otto Grosser (as quoted by Needham, 1931) as of the epithelio-chorial variety in which six tissue layers similar to those mentioned above intervene between the foetal and maternal bloods. The barriers between the two bloods in this variety of placenta are more numerous than in the other histological varieties such as the syndesmochorial, endothelio-chorial and haemo-chorial described by Grosser and consequently, the efficiency in the exchange of materials is correspondingly lower than those of the others. In the evolution of mammalian placentae, the epithelio-chorial variety is regarded as the most primitive and the haemo-chorial, the most highly evolved.

7. Unlike the mammalian placentae, a selachian placenta [except that of *S. sorrakowah*, *vide* (8) below], is usually formed at a fairly advanced stage of embryonic development when the various foetal organs and systems have already been formed and have presumably taken up their respective functions also. The intimate contact between the highly vascularised foetal and maternal tissues in this placenta leads one to the view that active diffusion is set up between the foetal and maternal circulation, that a vigorous transference of nutritive materials takes place from the maternal to the foetal blood, and vice-versa, a flow of excretory products in the opposite direction. (*vide infra*).

8. The placenta in *Scoliodon sorrakowah* is unique among the elasmobranchs thus far studied by me. The initial quantity of yolk in the mature ovum of this species being very small, the maternal organism is called upon to exert to the utmost, and very early too, in the nurture of the embryo. The maternal portion of the placenta takes the form of a very prominent, elongated process of the uterine mucosa—the trophonema, a highly glandular organ (Setna &

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[1] According to my anatomical findings, there exists between (iii) and (iv) above, the thin and hyaline, non-cellular layer of the shell-membrane which intervenes between the foetal and maternal tissues of all the entire and discoid placentae examined by me with the solitary exception of that of *Hemigaleus balfouri*.

Sarangdhar, *Rec. Ind. Mus.*, Vol. 46, 1949). The actual contact between the foetal yolk-sac and the maternal trophonema is, however, one of mere apposition (only the second stage in Ercolani's classification of selachian placentae) and not of an intimate interdigitation as in the other placenta elasmobranchs. Histologically, too, this placenta is unique in that free maternal blood is extravasated within the trophonema to supply nourishment, in part at least, to the growing embryo. In order to describe this tissue relationship between the mother and the foetus, we have had to create a new histological category, viz.—the 'haemo-epithelio-chorial' variety, a nomenclature in which the syllable 'haemo' stands for free maternal blood 'epithelio' for the 'maternal trophoblast' and the syllable 'chorial' for the foetal tissue, though however, it may be repeated that the latter tissue in fishes *is not a true chorion*. Curiously enough, this placenta displays close structural convergence towards that most highly evolved placenta in higher mammals, including man—the haemo-chorial variety in which, too, free maternal blood ('haemo') is extravasated for the direct nurture of the foetal tissue —the chorionic trophoblast. The significant difference between the two above-mentioned types of placentae is, however, at once apparent by the fact that while the maternal blood in mammals bathes a foetal trophoblast, that in *S. sorrakowah* bathes a maternal one—a difference which appears to be only in keeping with the view that the foetal tissue in such primitive vertebrates as fishes is not endowed with the higher physiological faculties of a true avian or mammalian trophoblast—faculties such as phagocytosis, selective absorption, elaboration and synthesis etc. which the ceaseless forces of evolution have so conspicuously bestowed upon the succeeding ascending classes of vertebrates, thus rendering their foetal tissue more and more independent of the maternal intervention.

Being structurally comparable to the most highly evolved haemo-chorial placenta of mammals and man, one may perhaps be led to suppose that functionally too, the placenta in *S. sorrakowah* is more highly evolved than the other variety among the elasmobranchs. The predominantly histotrophic condition of this placenta does not, however, warrant such a supposition, for, as already pointed by us (loc. cit.) the placenta in *S. sorrakowah* is functionally more a gland than a haemotrophic organ. Judging thus, (and this would be the only basis of consideration in placental nutrition) one must say that the placenta in *S. sorrakowah* is low in evolution (functional efficiency) in spite of the fact that it displays a surprising structural convergence towards the most highly evolved placenta among that highest class of vertebrata—the mammals.

EMBRYONIC ALIMENTATION IN ELASMOBRANCHS

Yolk is the complex food material prepared and stored in the ovum by the maternal organism for the use of the developing embryo. It consists of the highly specialised and elaborated organic and inorganic substances necessary for the building up of the embryonic tissues and organs, so that the embryonic cells are, in the initial stages at least, spared the task of elaboration and synthesis. In the ovum, yolk is tightly packed in the form of more or less solid granules or plates, but after the fertilization stimulus and the commencement of embryonic development, it is emulsified and liquified so as to become more mobile for distribution. The task of 'rendering the yolk-plates fit for absorption by blood' is, according to Beard (1896), performed, upto the critical stage[1], by the yolk-merocytes, so that the yolk may readily diffuse through the walls of the yolk-sac and the blood capillaries interspersed in its mesoblastic tissue. These merocytes are, according to the author, concentrated in the region of the yolk-sac blood-capillaries and their action on the yolk is to 'emulsify or prepare it for digestion and absorption'. This statement of Beard's needs, in my opinion, further elucidation so as to accord with the known bio-chemical principles of digestion and absorption.

Emulsification is a process by which a change is brought about only in the physical state of the yolk-granules and according to the modern concepts of the phenomenon of diffusion only crystalloids and gases are diffusible but not the colloids. Hence, even after the emulsification of a partial quantity of yolk in the sac (especially in the region of the yolk-sac blood capillaries where yolk merocytes abound), it is necessary that the complex colloidal granules be reduced chemically to the simpler crystalloid condition before their diffusion through the yolk-sac wall and those of its blood capillaries actually becomes possible. This change is effected, in all probability, by the yolk-sac blastoderm ('periblast' of teleostean fishes, R. Assheton, 1907) which, in fishes, is known to behave like a trophoblast to the extent that it brings about an *extraembryonic digestion* of the yolk in question. It is, however, reasonable to suppose that only a fractional quantity of the yolk is treated thus and conveyed to the embryonic circulation by diffusion—up to the critical stage of Beard, and that the major quantity of it is conveyed to the embryo, possibly unaltered and more directly along the yolk-duct into its intestine which, presumably along with the other organs of alimentation, has started functioning by that time of the embryonic development.

Balfour (1885) writes that both these modes of food absorption, viz., absorption of the nutritive yolk through foetal blood capillaries and the direct transference of yolk to the embryonic intestine continue simultaneously, whereas Beard (1896) suggests that the former alone exists upto the 'critical stage' and then the latter commences. Beard's suggestion that diffusion through yolk-sac blood-capillaries loses its importance at the 'critical stage' appears reasonable for, when once a direct communication is established between the yolk-sac and the embryonic intestine, the volume of yolk transference is bound to be greater along that direct route than by its indirect transference by the diffusion process. Nevertheless, it may be stated that the latter form of food transference does not dwindle but must actually increase in volume *than before*, for, an examination of the embryos in progressive development stages reveals that the yolk-sac blood capillaries actually increase in size and number with the growth of the embryo, thus affording a greater surface for contact and diffusion.

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[1] Critical stage is, according to Beard, that stage of embryonic development when the sex of the embryo is defined internally and externally.

The stages described above must occur not only in oviparous, ovo-viviparous and aplacental viviparous elasmobranchs but also in placental forms upto the stage at which the placenta is formed. In the latter group, the nutritional process after the formation of the placenta (epithelio-chorial) may be described on the following physiological basis. Simplified nutritive elements in the form of diffusible crystalloids and dissolved gases circulate in the (maternal) blood of the trophonematous villi (just as they do in the maternal blood in mammals) and diffuse through the various placental barriers into the foetal blood, whence they are carried away by the foetal circulation and distributed to the various organs and systems according to their respective needs. On the ground of their advanced anatomical development, it may be held that these organs carry out their own elaboration and synthesis from the requisite simplified elements derived originally from the maternal blood, thus participating actively in the foetal metabolism. Such an explanation of the functional activity of the placenta in this group is only in keeping with the view that a 'true trophoblast' is never developed in fishes as a class and with the observation that it is only formed at a fairly advanced stage of embryonic development which must yet proceed to bring the foetus to term.

Finally, no discussion of the selachian placenta can be regarded as complete without a mention of the 'appendicula'—structures appended to the umbilical cords (later, the placental cords) of placental elasmobranchs. Alcock (1890), to whom we owe their appropriate designation, was the first to describe them on the placental cords of the embryos of *Zygaena blochii* and he considered their probable function to be the absorption of the nutritive secretions of the gravid utrine mucous membrane. Southwell and Prashad (1919) have described four different kinds of appendicula in the elasmobranchs examined by them and they, too, are inclined to attribute to appendicula the same absorptive function as suggested by Alcock.

Being derived from the sheath of the umbilical cord appendicula ultimately bear relationship to the yolk-sac placenta. It is a curious phenomenon that they are not found to develop on the yolk-stalks or umbilical cords of aplacental elasmobranchs. The large quantities of yolk contained in the ova of such aplacental selachoids as *Galeocerdo tigrinus* and *Carcharinus dussumieri* (Mahadevan, 1940), supplemented by the nutritive albuminous secretions of the nidamental glands, suffice, in all probability, to meet the nutritive needs of their embryos throughout their intrauterine life. Hence, the need for the uterine secretions and their absorption by such extraneous structures as appendicula must not arise in them at all. More or less parallel conditions may be said to prevail among the Batoids, which, too, are non-placental. They, too, possess large ova and the yolky food is supplemented in them by the milky nutritive uterine secretions which are poured directly into the pharynx of the developing embryos by the trophonematous villi developed all over the mucous membrane of the gravid uterus. The various foetal and maternal structures in these elasmobranchs, developed, though temporarily during the emergency, are evidently sufficient in themselves to cope with all this nutritive material and the necessity of appendicula does not arise in them at all.

In the placental elasmobranchs the initial quantity of yolk in the mature ovum and the functional efficiency of the placenta developed appear to be two important factors influencing the production of additional nutritive uterine secretions and consequently, the development or otherwise of the appendicula on the umbilical cords of their embryos. Southwell and Prashad (loc. cit.) have attempted to describe four different grades of appendicular development in the few elasmobranchs examined by them and four corresponding grades of placental evolution in the inverse ratio. On the basis of their observations they conclude: 'In the species with the best developed appendicula, the placenta is of the most primitive and least evolved type and vice versa', thus postulating a regular inverse relationship between appendicular development and placental evolution among elasmobranchs. Evidently they did not take into account that there could be factors other than placental efficiency which could influence the development of appendicula on the cords of the embryos. I cannot, however, help remarking here that this attempt of the authors at thus grading and correlating appendicular development and placental efficiency is purely an empirical one, in view of the facts that not only is the very anatomy of the placentae erroneously described by them, but also that they have not furnished any reasonably acceptable basis for assaying the differential development of the appendicula or the corresponding grades of placental efficiency. Thus, for example, they describe the placentae of *S. sorrakowah* and *S. palasorrah* as being anatomically similar—of the simple contact type, whereas, in point of fact, the placenta of *S. palasorrah* is of the firm inter-digitating type (*vide* Table). They also describe the placenta of *S. walbeehmi* as being of an altogether different type, whereas factually this placenta, as well as that of *S. palasorrah*, is of the same inter-digitating type, representing the epithelio-chorial variety histologically. Further, according to the authors, the appendicula in *S. walbeehmi* and a *Scoliodon* sp. from Ceylon belong to two altogether different grades of anatomical development and yet their placentae are described as belonging to the same grade of evolution—the arborescent type—the type which corresponds to none other than the inter-digitating type of placentae described by me in almost all the placental forms with the exception of *S. sorrakowah*.

Whither then the authors' postulation of a regular inverse relationship between the appendicula and the placentae? While the above-quoted statement of Southwell and Prashad may be said to hold good only in the solitary and extreme case of *S. sorrakowah*, and that, too, only with a certain reserve[1] the converse of the statement does not seem to hold good, for I cannot trace any regular, inversely-proportioned relationship between the appendicular development and the placental evolution in the appendiculated forms studied by me, viz., the four species of *Scoliodon*, *H. balfouri*, *H. elongatus* and the two species of *Sphyrna*.

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[1] It must be borne in mind that in *S. sorrakowah* the excessive appendicular growth cannot be solely correlated to the very poorly developed placenta, it being equally true that even the initial quantity of the yolk in the mature ovum in this species is a negligible quantity—a factor which must, in part at least, influence the appendicular growth in this form. (*vide* Setna and Sarangdhar—*Rec. Ind. Mus.*—XLVI, Pts. 1-4-1949.)

A scrutiny of the table as also the diagrams will at once reveal that in all these forms the placenta is of the same anatomical variety, viz., the inter-digitating, epithelio-chorial variety (and hence presumably of the same grade of functional evolution) while their appendicula present a variety of morphological features with varying grades of anatomical development, the determination of the exact comparative extents of which must border, indeed, on the realm of mere speculation. Any attempt, therefore, to correlate the latter with placental evolution in the inverse ratio as postulated by Southwell and Prashad, at once falls through, especially when one takes into consideration all the different aspects of embryonic nutrition among elasmobranchs. Regarding these 'anatomically equal' placentae as equal in functional efficiency as well (and there seems to be no criterion to regard them otherwise), one may only attribute any differences in the development of the appendicula to the corresponding differences—in the inverse ratio—in the initial quantities of the yolk contents of their mature ova which, it must be assumed, are not sufficient to bring about in conjunction with the placental nutrition, the complete intra-uterine development of the foetuses, and hence make necessary the secretion of the uterine juices in corresponding supplementary amounts.

SUMMARY

I. The placentae in 14 out of the 15 elasmobranchs examined by the author are of the inter-digitating type, in which the folds of the original yolk-sac wall fit into the crypts between the villi of the uterine trophonemata. They are also adeciduate in character and in this respect resemble those of the ungulate mammals. Histologically, they resemble the epithelio-chorial variety of placentae in mammals.

II. Two morphological varieties of the above-mentioned placentae are described, viz., 'entire' and 'discoid'.

III. The placenta in *Scoliodon sorrakowah* is of the 'haemo-epithelio-chorial' variety histologically, imitating the haemo-chorial placentae of higher mammals, including man. The author postulates the presence of a 'maternal trophoblast' in *S. sorrakowah*.

IV. In most of the non-placental elasmobranchs, as well as some placental forms, the yolky nutriment in the ovum is supplemented by the uterine 'histotrophe'. In the latter group, the secretion of the histotrophe appears to vary inversely with the initial quantity of the yolk in the mature ovum as well as the efficiency of the placenta developed.

The development of appendicula seems to vary directly with the secretion of the histotrophe.

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N.B.—Ercolani and Grosser have been quoted from Needham, 1931 and Ranzi from Needham, **1942**.

GROWTH-GRADIENTS OF INDIAN ELEPHANTS[1]

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(*With eleven figures*)

CONTENTS

PAGE
I. INTRODUCTION 841
II. THE ABSOLUTE GROWTH OF THE BODY-SIZE 842
III. ALLOMETRICAL GROWTH OF SOME PROPORTIONS 845
IV. SUMMARY 851
V. LITERATURE. 851

I. INTRODUCTION

Modern taxonomy is no more confined to characterize animals by absolute measurements. It is also necessary to comprehend the correlations connecting the single parts of the body with one another and with the body as a whole. Ontogenetic analysis shows in very many cases that organs or parts of the body rather rarely grow at the same speed as the whole body (i.e. isometrically) but relatively quicker (i.e. positively allometrical) or relatively slower (i.e. negatively allometrical). Therefore each stage of the growing animal has other proportions. In very large specimens the growing parts with positive allometry become excessively large, the growing parts with negative allometry excessively small. And in most cases two adult specimens of the same species or two related races differing in body-size, will automatically differ in other characters correlated with body-size too (cf. J. Huxley 1932, B. Rensch 1947, 1954).

Up to the present only absolute measurements of Indian elephants have been published. Hence, in the course of investigating the behaviour of working-elephants in Mysore in spring 1953 (cf. B. Rensch & R. Altevogt 1955), we took the opportunity to study also the growth-gradients of some proportions. We took measurements of 15 elephants of different ages and different body-size and tried to find out some postnatal growth-gradients of these largest land mammals. We could complete these statements by calculations based upon the absolute measurements of elephants of Ceylon published by P. E. P. Deraniyagala (1953).

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[1] This investigation was kindly supported by grants from the 'Deutsche Forschungsgemeinschaft' and of the Kultusministerium of the Land Nordrhein-Westfalen, W. Germany.

For kind support of our investigations we wish to express our gratitude to our friend Sálim Ali (Bombay), to the District Forest officer Mr. Gulab Singh (Mysore), to the veterinary officer Mr. M. D. Raghunatha Rao (Mysore), to the head of the elephant-stable in Mysore, Mr. D. S. Eswarappa, to several other Indian forest officers, and also to the members of our scientific party Mrs. I. Rensch, Dr. (Miss) A. Nolte and Dr. R. Altevogt.

II. THE ABSOLUTE GROWTH OF THE BODY-SIZE

Statements of the age of Indian elephants are not always reliable, because most animals are not born in captivity and their age has only been estimated after the capture. Especially in older publications this estimation often is too high. We now know that Indian elephants do not reach an age of 80-150 years, as W. T. Blanford (1891), G. H. Evans (1910) and others maintained, but that they reach an age of 60-70 years normally. The age of the two oldest animals investigated by us has been estimated as 62 (♂) and 60 years (♀), and in P. E. P. Deraniyagala's publications (1951, 1953) the oldest specimens measured were 65 (♂) and 55 years (♂). In view of this factor of inaccuracy we have to expect a relatively large variation of the values, if we relate body-size to growth. But in practice the range of variation can be lowered by averaging two neighbouring values and plotting such average data in a system of co-ordinates with the increasing measurements of head and body on the abscissa and the increasing age on the ordinate.

Figure 1 shows our own measurements and also those of Deraniyagala (1953). We measured the length of head + body from the frontal base of trunk to the hind part of pelvis region by plotting corresponding distance on the ground beside the elephant. Deraniyagala measured from the ear-hole to the root of the tail, but apparently directly along the vaulted body. These measurements correspond with ours to a high degree. The distribution of the values follows the usual curve of growth (fig. 1) showing a quick increase at the beginning and then a successive slackening of the growth. The curve shows that Indian elephants are not fully grown, before they have reached an age of 25 years, but that afterwards a little growing continues until a high age. Therefore, on the average, the oldest specimens are the largest ones. On the average males are a little larger than females. By plotting the maximum height of the back into a system of co-ordinates in a corresponding manner we got a similar result.

Table 1 shows the absolute values of the animals measured by ourselves. Measuring the heights of shoulder and back was done by using a stick, which was held horizontally across the relevant points of the elephant's body so that a straight vertical line leading from the ends of the stick to the ground could be taken as the real height. The length of the ear corresponds with a vertical line from the upper margin of the ear to its lowest point. The width of the ear corresponds to a line crossing vertically and connecting the anterior margin with the hindmost tip of the ear. The upper parts of the ear, which are tilted over in older elephants were not flattened out for measurements. We measured the length of the forefoot up to the elbow, the length of the hindfoot up to the knee and the circumference of forefoot and hindfoot with a thread around the hoofs.

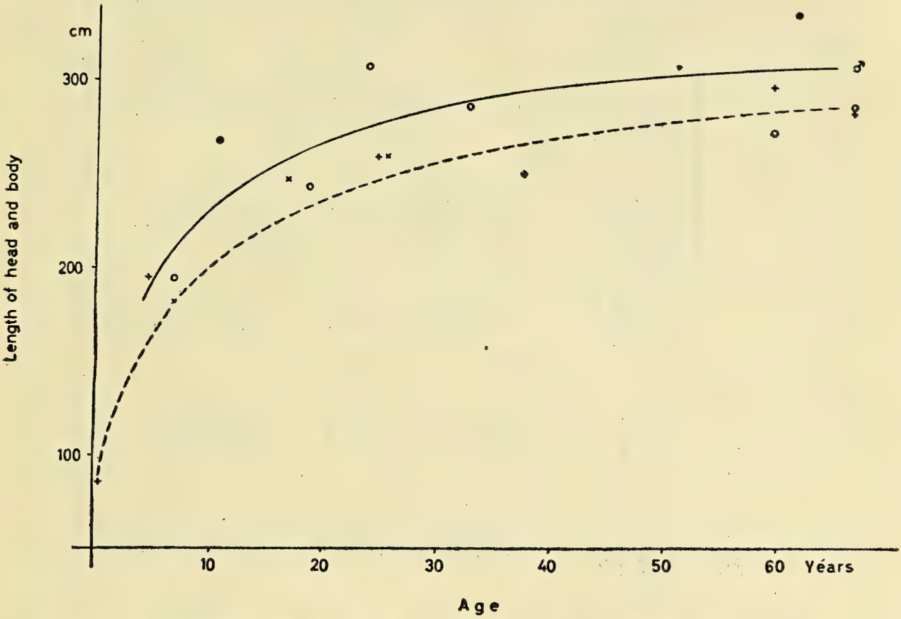

FIG. 1 : Absolute growth of the length of head and body. Each spot is the mean value of 2 specimens, in 5 extreme cases the value of 1 specimen. + females, . males from Mysore; x females, o males from Ceylon (ear-hole to root of tail, measured by Deraniyagala).

The oldest male (Elephant Stable, Mysore) was the largest specimen measured (table 1). Its length of head + body was 335 cm. and its height (of back) was 310 cm. According to the statement of Mr. Eswarappa its weight was 6 tons and 224 English pounds = 6198 kg. But the average of the values of head + body of 6 adult females older than 24 years is only 269 cm; and the height at the shoulder averages only 242 cm.

The largest Ceylon elephant measured by Deraniyagala was a younger male of 32 years having a length of head + body (ear-hole to root of tail) of 315 cm. G. H. Evans (1910) measured a male from Burma, in which height of back was 360.7 cm. S. S. Flower (1914) mentioned a male measured by Sanderson in which height of back was 323.9 cm., but he thinks that the normal maxima are 274 cm. for males and 244 cm. for females. L. Heck (in Brehm's 'Tierleben' 1930) mentioned a height at shoulder up to 3 m. as maximum and a highest weight of 4000 kg. or even more. H. Heck (1932) reported that the largest Indian Elephant of the Zoological Gardens he knew was the male 'Harry' of the Berlin Zoo: age about 52, height 3.15 m., weight about 7500 kg.

An old rule pretends that in elephants the height at shoulder is about twice the circumference of the forefoot. As table 1 shows this holds good for our measurements, the error being less than 5 per cent.

TABLE 1

Absolute Measurements of Indian Elephants

Sex	Age	Locality	Head + body in cm.	Maximum height of back in cm.	Height of shoulder in cm.	Length of ear in cm.	Width of ear in cm.	Length of fore-leg up to elbow	Length of hind-leg up to knee	Circumference of fore-foot	Circumference of hind-foot
♀	4 month	Mysore ...	85	95	93	31	23	42	34	50	49·5
♀	4–5 years	,,	195	179	...	52	38	74	64	87	73
♀	5–7 years	,, (Albino)	196	190	177	45	46	77	60	87	84
♀	25 years	,,	252	236	229	59	53	101	89	110	107
♀	25 years	,,	265	236	232	64	57	95	84	113	107
♀	35 years	,,	242	245	235	73	66	100	82	116	117
♀	40 years	,,	260	253	238	74	70	98	84	117	112
♀	60 years	,,	263	238	241	78	66	94	84	128	117
♀	60 years	Siwalik-Hills ...	330	...	275	85	...	...	...	...	...
♂	2½ years	Mysore ...	...	142	135	41	37	58	61	70	68
♂	6 years	,,	...	192	178	46	46	74	64	89	84
♂	11 years	,,	268	233	...	63	56	85	78	107	97
♂	15 years	,,	...	231	223	64	56	99	80	116	110
♂	25 years	,,	...	230	230	60	56	97	83	about 113	about 98
♂	62 years	,,	335	310	...	74	71	125	112	155	139

III. ALLOMETRICAL GROWTH OF SOME PROPORTIONS

If a part of a body grows allometrically, i.e. if the growth ratio in relation to the body remains constant for a certain time, then the growth follows a rule stated by J. Huxley: $y = b.x^a$, meaning: size of the organ$=$b. body-size^a. The exponent *a* is the coefficient of correlation between organ and body, whereas b is a constant of integration, which indicates the value of the organ when the body-size is 1. Now this allometry-formula may also be written $\log y = \log b + a.\log x$. That means that allometrical increase of an organ or of a part of the body can also be shown by plotting the size of the organ on the ordinate and the body-size on the abscissa of a system of co-ordinates progressing logarithmically in both directions. If the organ grows allometrically, the values will coincide with a straight line. The angle of inclination of the straight line is a measure of the degree of allometry.

Of course, it is also possible to show the correlations between organs and body-size by plotting the body-size on the abscissa and the relative organ-size (in per cent of the body-measurement) on the ordinate of a *normal* system of co-ordinates. But in most cases the variation of values will be fairly large and the allometry, i.e. the constancy of the relative growth-ratio, will not be proved so exactly.

If we examine the *height of shoulder* (fig. 2) and the *height of back* (fig. 3) by double logarithmical plotting of the absolute values, we see that in both cases the values rather exactly form a rising straight line. As the inclination angle is less than 45° the growth is negatively allometrical. Hence the height of a young elephant is relatively greater in relation to body-length than in older animals. This proportion decreases constantly parallel with increasing age. The same holds good

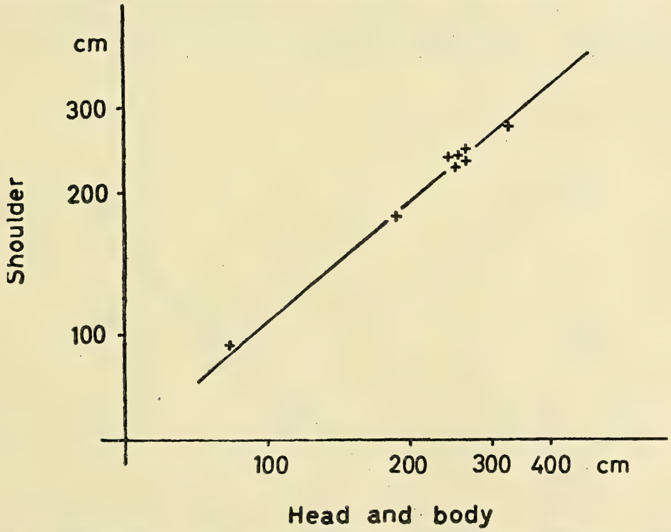

FIG. 2: Allometrical growth of height of shoulder in females from Mysore. Abscissa: length of head and body, ordinate: height of shoulder. Double logarithmic plotting.

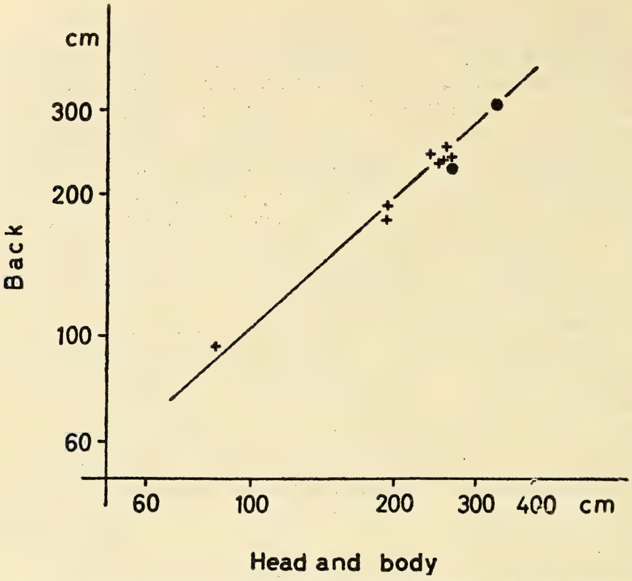

FIG. 3: Allometrical growth of height of back (Ordinate). + females, . males from Mysore.

for the *length of the foreleg* (fig. 4). Here the variation of the vales is a little larger. Especially the value of the young female of about

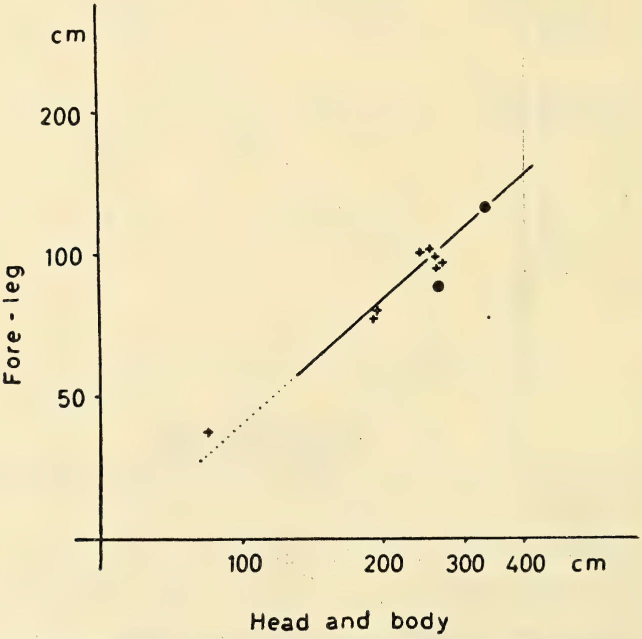

FIG. 4: Allometrical growth of length of fore-leg (Ordinate). +females, · males from Mysore.

3 months does not coincide with the straight line. This means that the negative allometry is more intense at the beginning. The same holds good for the *length of the hind leg* of the baby. But afterwards the growth becomes isometrical. Apparently the relative height of shoulder and back is chiefly determined by this successive alteration of the relative length of the legs. In this respect elephants have developed phylogenetically parallel with other hoofed animals as Perissodactyla and Artiodactyla, which also show a relatively larger length of legs in young animals. The phylogenetic development of such a growth-gradient probably took place because it is an advantage, enabling a young animal to run quickly. Supposing that the young animals would have the same relative length of legs as the adults, they would also run *relatively* quicker than the adult animals, because the capability of function of the legs grows proportionately to the cross sections of the muscles in the second power, but the volume of the body in the 3rd power. But the *absolute* speed of the young animals, which is important for selection (flight from enemies, long marches to watering places etc.), would be less. But by developing relatively longer legs than the adults in the course of phylogeny, their absolute speed is increased. During the individual growth the legs successively become shorter, showing a negative allometry.

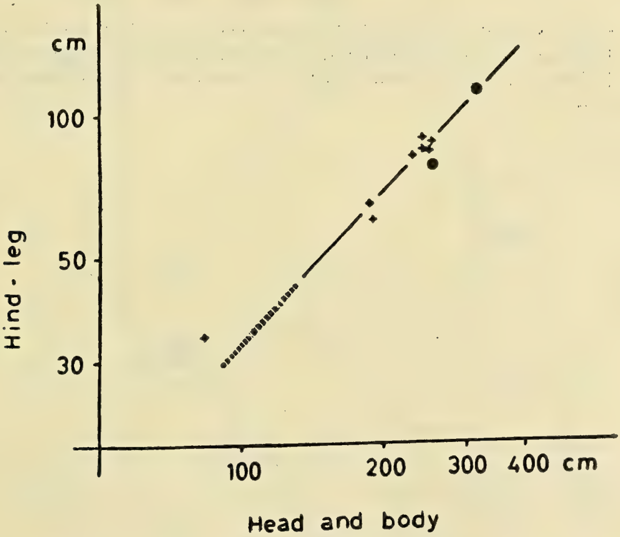

Fig. 5: Allometrical growth of length of hind-leg (Ordinate). + females, • males from Mysore.

Also the *circumference of the forefoot* (fig. 6) shows slight negative allometry, and in this case likewise the value of the 3 months old calf is not on the straight line. Young elephants have relatively broad feet. The *length of the hindfoot* begins with negative allometry (baby), but afterwards shows slight positive allometry (nearly isometry). In these cases we could add also the values calculated from the tables by

Deraniyagala. They fit into the range of variation of the animals measured by ourselves in Mysore. Deraniyagala's data (unfortunately there were no values from young ones) also enabled us to calculate

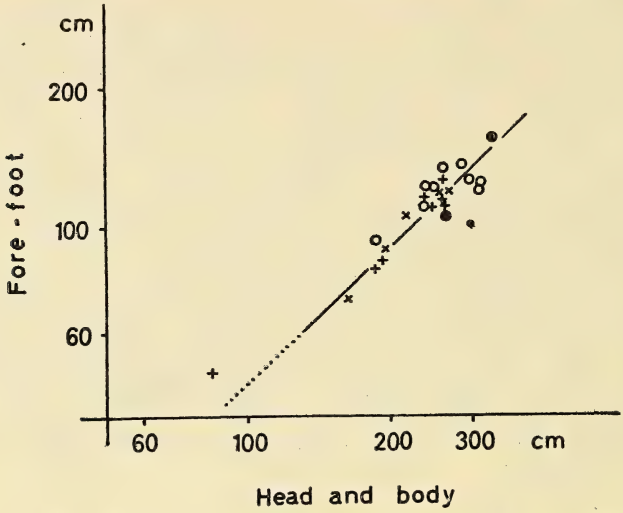

FIG. 6: Allometrical growth of circumference of forefoot (Ordinate). Abscissa: length of head and body (specimens from Ceylon measured from ear-hole to root of tail). + females, · male from Mysore, x females, o males from Ceylon (after Deraniyagala).

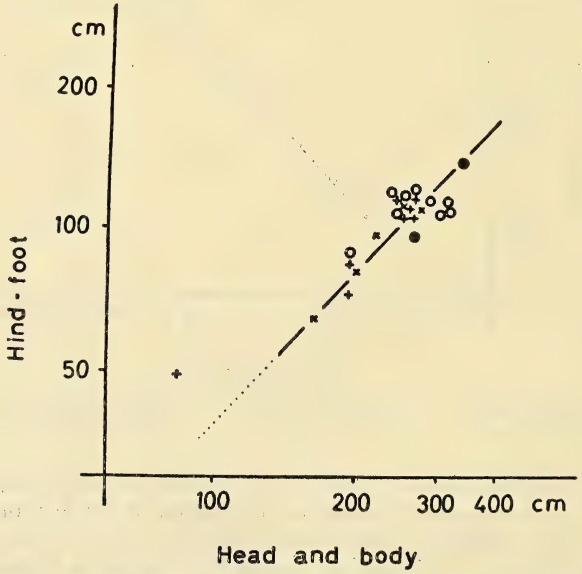

FIG. 7: Allometrical growth of circumference of hindfoot (Ordinate). + females, · males from Mysore; x females, o males from Ceylon (after Deraniyagala).

the growth-gradients of the *trunk* (fig. 8) and of the *tail* (fig. 9). The former grows with negative allometry, the latter isometrically. But

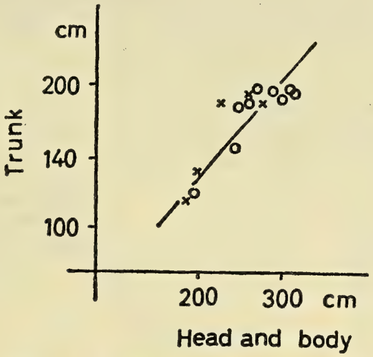

FIG. 8: Allometrical growth of length of trunk (Ordinate) x females, o males from Ceylon (after Deraniyagala).

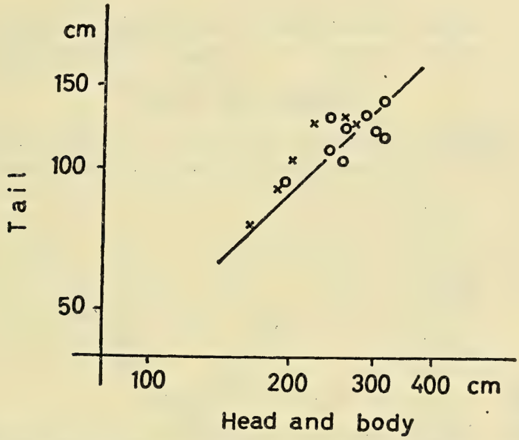

FIG. 9: Allometrical growth of length of tail (Ordinate). x females, o males from Ceylon (after Deraniyagala).

the variation of the values is larger, apparently caused by the inexactness of measuring not to be avoided here. Finally the growth-gradients of *length of ears* (fig. 10) show slight negative allometry. Once again in the youngest female a higher degree of allometry shows up. The *width of the ear* (fig. 11) at first grows with negative, afterwards with positive allometry.

There is a similar behaviour of all these growth-gradients in both sexes.

In this connection it is also of interest to compare the *foetus* 7.5 cm. long and figured by Deraniyagala. This specimen has a relatively large head and relatively large eyes, that is to say, after birth head and eyes grow with negative allometry like in other mammals. But the ears are relatively small. Apparently they grow with positive allometry till birth and later on, as we have seen, with negative allometry, but the width once again with positive allometry. The legs of the foetus are relatively long and the back is relatively high, and even relatively higher than in the young female of 3 months. Probably the negatively allometrical growth of the height of the back already begins at such small embryonic stage.

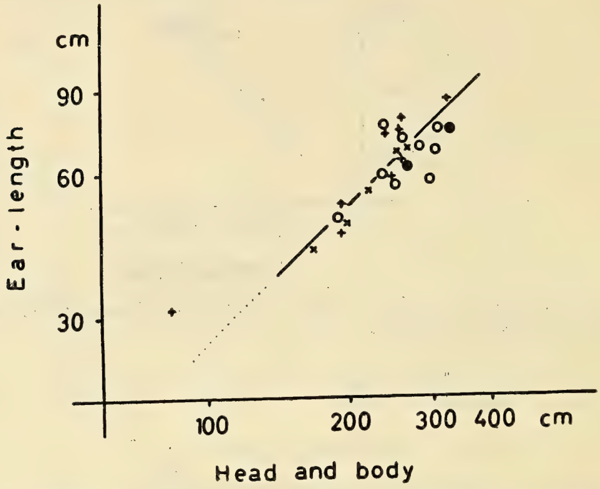

FIG. 10: Allometrical growth of ear-length (Ordinate). + females, • males from Mysore; x females, o males from Ceylon (after Deraniyagala).

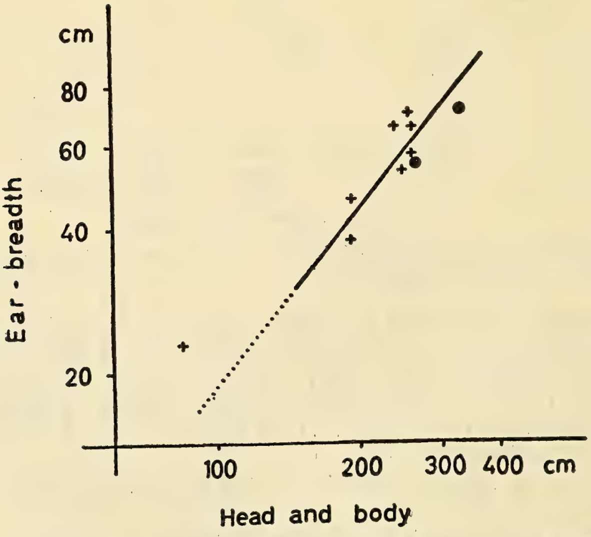

FIG. 11: Allometrical growth of ear-width (Ordinate). + females, • males from Mysore.

So far as we know the growth-gradients of the interior organs of Indian elephants have not yet been investigated. Corresponding quantitative statements of African elephants compared with the data of other hoofed animals were published by D. P. Quiring (1939 *a*, *b*). From a study of the plates by J. E. Boas and S. Paulli (1925) who investigated the head of Indian elephants at different ages, we may learn, that the face-bones, especially the nasals show a strong positive allometry, the parietals a strong negative allometry. This corresponds with the phylogenetic tendencies. Elephants derived from very much smaller ancestors, the positive allometrical growth of the face-bones of which must have led, so to say automatically, to excessive tusks and excessive nasals, when the single lines of descent became successively larger following Cope's Rule (cf. B. Rensch 1947, 1954). By comparing the plates (p. 18-20), it can be stated that the brain grows with strongly negative allometry in relation to body-size. There is a slightly negative allometry in the growth of the cerebellum in relation to the whole brain.

IV. SUMMARY

1. Measurements of 15 working elephants in Mysore confirmed the opinion that *Elephas maximus* is fully grown at an age of about 25 years. Afterwards a slow growing continues up to a high age. The length of head and body of 6 females older than 24 years averaged 269 cm.; the height of shoulder 242 cm. In the largest male, 62 years old, length of head and body was 335 cm. and height of back was 310 cm.

2. Height of shoulder and back, length of foreleg, circumference of fore-foot, and length of ear grow with negative allometry during postnatal development, whereas trunk (calculated after the absolute data published by P. E. P. Deraniyagala) and width of ear grow with positive allometry. The tail (measurements of Deraniyagala) and the hind-leg grow isometrically. But in a baby about 3 months old the hind-leg and the width of ear still shows negative allometry. Allometry in very young elephants needs further investigation.

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NYCTIBATRACHUS HUMAYUNI, A NEW FROG FROM THE WESTERN GHATS, BOMBAY[1]

BY

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(*With a plate*)

With field notes by Humayun Abdulali

In August 1953, Mr. Humayun Abdulali of the Bombay Natural History Society collected five frogs and a few tadpoles which he believed to be *Nyctibatrachus major*, from a wayside hill-stream at Khandala, Western Ghats, Bombay, and sent them to us for determination. In October of the same year, he supplemented this collection with a few more tadpoles collected from some hill-streams on the Devimani and Bundel Ghats near Sirsi in North Kanara, South Bombay. In November, at his instance, Mr. D. J. Panday collected two frogs and a few tadpoles from a stream at Mahableshwar. This material was also at our disposal for study.

The frogs though agreeing in general with Boulenger's (1882) description and figure of *N. major* did not agree with any of the named material in the Reserve Collection of the Zoological Survey of India. On comparison with a topotype of *N. major* from Malabar, kindly loaned by Dr. H. W. Parker of the British Museum of Natural History, we find that the Khandala and Mahableshwar frogs are specifically distinct from *N. major*. Incidentally it may be pointed out here that a couple of frogs that were later collected by Mr. J. C. Daniel of the Prince of Wales Museum, Bombay, in Travancore agreed fully with the topotype of *N. major*.

With the intention of studying the frog in its natural surroundings and obtaining more material, Mr. Abdulali persuaded Dr. Bhaduri to visit Khandala and Mahableshwar during his short visit to Bombay in the first week of August 1954. Bombay had, however, experienced an unusually heavy monsoon, the rainfall on August 7 being ten inches. Only a single tadpole isolated in a small puddle was noticed in the Khandala stream where Mr. Abdulali had seen many frogs and tadpoles on 18th July. All the wayside streams were in torrents where no frogs were visible. Panchgani and Mahableshwar were also excessively wet. Except for the constant call of the elusive *Philautus bombayensis* in the hilly tracts of Khandala, Panchgani and Mahableshwar, and a number of the interesting tadpoles of *Rana leithii*

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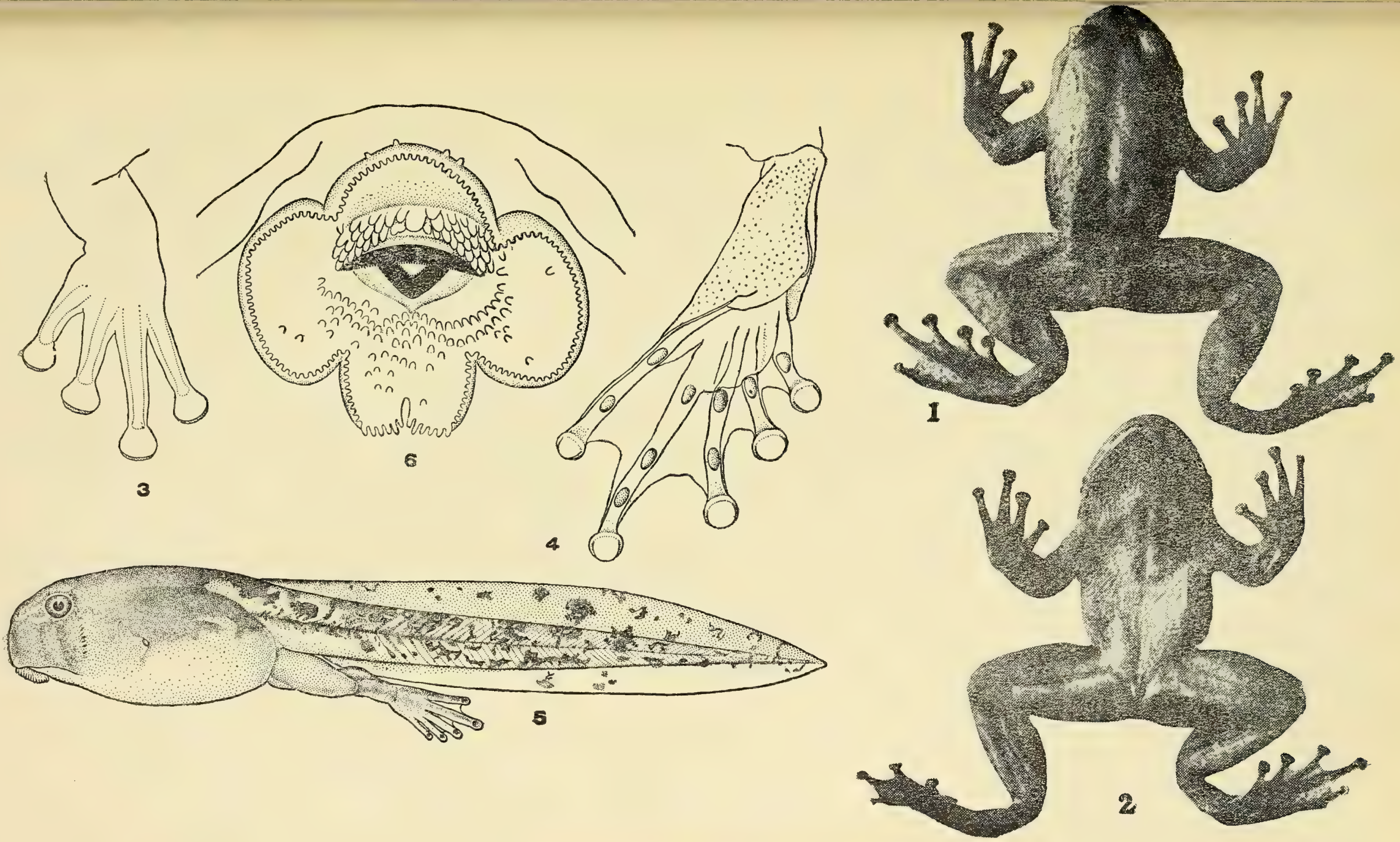

Nyctibatrachus humayuni, new species

Fig. 1. Dorsal view. (nat. size)
Fig. 2. Ventral view. (nat. size)
Fig. 3. Ventral view of hand, showing circummarginal groove ($\times 2\frac{1}{3}$).
Fig. 4. Ventral view of foot ($\times 2\frac{1}{3}$).
Fig. 5. Lateral view of tadpole ($\times 2\frac{1}{3}$).
Fig. 6. Mouth disk of the tadpole ($\times 14\frac{2}{3}$).

which kept to almost vertical wet rocks at Panchgani, we saw very little of Salientian interest. It seemed that weather conditions were not favourable for the free movement of frogs.

Mr. Abdulali first discovered these frogs at Khandala and collected tadpoles fom other localities. In recognition of the amphibian collections which he has been making within recent years, we have much pleasure in describing this new species after him.

Nyctibatrachus humayuni new species

Diagnosis: A *Nyctibatrachus* with an erect pupil; tongue free and deeply notched behind; vomerine teeth behind the chaonae, in transverse patches, each with a single row of teeth; tympanum hidden; fingers free, toes webbed, tips of all digits strongly dilated into large disks with a deep horizontal circummarginal groove separating the upper from the lower surface; outer metatarsals separated by web. Omosternum forked at the base and sternum with a bony style. Terminal phalanges bifurcate.

Holotype. Adult male, Z.S.I. Cat. No. 20628 (B.N.H.S. Cat. No. 576); collected from a wayside hill-stream, Mahableshwar, Satara District, Bombay, by Mr. D. J. Panday on November 17, 1953.

Paratypes. Six specimens: one male, B.N.H.S. Cat. No. 577, collected at the same place and on the same date as the holotype by Mr. D. J. Panday, and five specimens, B.N.H.S. Cat. Nos. 775, 427-430, consisting of two males, two females and one juvenile from a wayside hill-stream, Khandala, *ca.* 1,500 ft., Bombay, collected by Mr. Humayun Abdulali on August 30, 1953. Three each are deposited in the collections of the Zoological Survey of India and the Bombay Natural History Society.

Description. Body depressed and stout, not constricted at the waist. Head depressed and distinctly broader than long; snout short and rounded, not projecting beyond the mouth, nearly equal to the diameter of the eye; without canthus rostralis; nostril midway between the tip of the snout and the anterior corner of the eye; eyes prominent with a vertical pupil, directed forwards and upwards; upper eyelid narrow; interorbital space about twice the width of the upper eyelid and broader than internarial space; tympanum obscure, hidden under the skin; tongue moderately large, free and deeply notched behind; vomerine teeth patches in two slightly oblique series, each with a single row of 6-8 teeth, separated by a narrow space, and set well behind the choanae.

Forelimb rather stout, fingers free and moderately long, somewhat flattened dorsoventrally; first finger shorter than second, third finger longest, fourth finger just reaching the base of the disk of the third finger, second slightly shorter than fourth. Tips of all the fingers dilated into large disks with a horizontal circummarginal groove separating upper from lower surface; disks practically of the same size except the fourth which appears to be slightly smaller. Subarticular tubercles feebly prominent, one or two tubercles on the palm.

Hindlimb stout and moderately long, the tibiotarsal articulation reaching beyond the eye; toes webbed and somewhat flattened fourth toe the longest, third and fifth subequal, nearly reaching the distal subarticular tubercle of the fourth, the second nearly reaching the distal subarticular tubercle of the third, and the first reaching a little below the base of the disk of the second; toes fully webbed except the fourth on which the web reaches the distal subarticular tubercle, with fringes continuing to the base of the disk; tips of all the toes dilated into large disks with a horizontal circummarginal groove separating upper from lower surface; subarticular tubercles moderately developed; a deep fold of skin on the outer side of the fifth toe; a small elongate inner metatarsal tubercle; no outer metatarsal tubercle.

Measurements in millimetres

	♂	♂	♂	♂	♀	♀	Juv.
Sex	1	2	3	4	5	6	7
Body length	41	46	36	34	47	48	17
Head length	12	15	12	11	15	16	...
Head width	17	20	15·5	15	20	19	...
Snout	6·5	7	5·5	6	6·5	6·5	...
Eye	5·5	6	5	4·5	7	6·5	...
Interorbital space	6	6	5	5	6	6	...
Arm length	25	2	20	20	26	25	...
Hand length	14	14	11	11	14	14	...
Disk of third finger	2	2	2	2	2	2	...
First finger	8·5	9	6·5	7	9·5	9	...
Second finger	11	11·5	9	9	11	10·5	...
Third finger	14	14	11	11	14	14	...
Fourth finger	12	12	10	9	11·5	11·5	...
Leg length	64	66	54	50	68	66	...
Tibia length	21	22	18	18	22	21	...
Foot	22	22	18	17	22	22	...
Disk of fourth toe	2	2	2	2	2	2	...
Fifth toe	15	16	12	12	14	14	...
Fourth toe	19	19	16	15	20	19	...
Third toe	15	14·5	13	12	15	15	...
Second toe	11	11	9·5	9	10·5	10·5	...
First toe	7	7	6	7	7·5	7	...
Inner metatarsal tubercle	3·5	3	3	3	3	3·5	...

1. Holotype from Mahableshwar. 2. Paratype from Mahableshwar. 3-6. Paratypes from Khandala. 7. A juvenile specimen from Khandala.

Skin above with very small closely set vermiculated folds; a rather distinct oblique fold beneath the eye; upper eyelid with strong tubercles.

Colour (in alcohol) grayish or brownish black dorsally conforming to the rock, with markings, if present, irregular and darker; ground colour of ventral parts slightly gray and usually with dark mottlings on the chin and the throat; limbs with indistinct, or without, dark cross bars or spots.

Sexes not distinguishable externally. Males with no vocal sacs. Testis small and oval. Ovum in one of the female specimens measures about 2.7 mm.

Habitat. Hill-streams, living under the stones in crevices.

Remarks. So far four species of the genus *Nyctibatrachus* are known. These are *N. pygmaeus* (Günther 1875) from the Anamallai Hills, *N. major* Boulenger 1882 from Malabar and Wynad, *N. sanctipalustris* Rao 1920 from Coorg and lastly *N. sylvaticus* Rao 1937 from Hassan, Mysore. While describing the last-named species, Rao observed that the former three species were present in good numbers in the zoological collections of the Central College Bangalore.

Myers (1942) rightly suggested *N. major* to be the type species of the genus.

N. humayuni is closely related to *N. major* in all the essential characters, especially in having fully-webbed toes and tips of digits dilated into disks. But it is distinct from *N. major* in that its disks are very much larger and provided with a deep circummarginal groove separating the upper from the lower surface. Furthermore, in coloration *N. major* is brownish, while *humayuni* is grayish black.

Distribution. Western Ghats (N. Kanara, Mahableshwar and Khandala), Bombay.

Until now *Nyctibatrachus* has been recorded in Anamallai Hills, Wynaad, Coorg and Mysore. With the discovery of *N. humayuni* the range of distribution of the genus extends northwards to Khandala through N. Kanara and Mahableshwar.

DESCRIPTION OF THE TADPOLE

The tadpoles are of moderate size; the head and body narrowly oval, flattened moderately, the ventral surface being slightly convex; the snout region bluntly rounded and depressed, the nostrils rather widely separated, nearer the tip of the snout than the eyes, the distance between them being less than the interorbital width; the eyes are dorsolaterally placed, directed forwards and upwards, situated at about one-third the distance between the tip of snout and the base of hindlimbs, nearer the tip of the snout than the spiracle. The spiracle is lateral, sinistral, tubular, pointing upwards and backwards, nearly midway between the tail and the tip of the snout. The vent is dextral and tubular.

The tail which is about one and a half times as long as the head and body, gradually tapers to a rather blunt point. The tail membrane is deeper dorsally, decreasing in height towards the base of the tail. The dorsal and ventral membranes arise just behind the base of the hindlimbs. The muscular portion is strongly developed tapering to a fine point.

The mouth-disk is small, directed downwards and a little backwards. The mouth is surrounded by anterior and posterior lips which are continuous through lateral folds. The anterior lip is distinct, crescentic in shape and can be closed down over the mouth. It is fringed with short, blunt papillae and shows 3-4 rows of similar papillae at its base just above the upper beak. The posterior lip is divided into three lobes, of which two are lateral in position and slightly larger than the posterior mesial lobe; the upper part of these lobes is capable of being folded backwards, the posterior mesial lobe may be broken into two or more sublobes which are edged with short processes; similar processes are scattered on the three lobes near the base of the lower beak. Both parts of the beak well developed, the upper beak relatively broader than the lower, which is a little stouter and V-shaped; both parts finely serrated; the upper is entirely black and the basal part of the lower beak is white.

The colour of the dorsal surface of the head and body and muscular portion of the tail is dark brown with irregular darker markings. The ventral surface is whitish.

Measurements (in millimetres) of a specimen with legs half developed:

Total length	47
Length of head and body	18
Body width	8·5
Tail length	29
Tail height	6

SPECIMENS OF TADPOLES EXAMINED

Reg. No. B.N.H.S.	Locality	Date	Collected by	No. of tadpoles
578	Mahableswar, Bombay ...	17-11-1953	D. J. Panday	8
776	Khandala, Bombay ...	30-8-1953	H. Abdulali	6
422	,, ,, ...	,,	,,	3
572	Stream under culvert No. 211, on Bundel Ghat, 1,500 ft., N. Kanara.	20-10-1953	,,	14
566	,, ,,	23-10-1953	,,	4
*571	Stream under culvert No. 413 Khandala.	19-10-1953	,,	3
*569	In eddy of small flowing stream of Devimani Ghat, 1,500 ft., Sirsi District, N. Kanara.	20-10-1953	,,	2

Remarks. Among the different lots of tadpoles examined by us, the tadpoles from Mahableshwar represent a good series of the main developmental stages. An almost metamorphosed frog shows nearly all the characters of the adult already described.

Annandale (1918) described the tadpoles of *Nyctibatrachus pygmaeus*, *Rana leptodactyla* and *R. semipalmata* among the many other tadpoles from south India. In the following year he made a correction by referring the *N. pygmaeus* tadpoles to those of *Philautus* (=*Ixalus*) *variabilis*. Incidentally, he has, however, mentioned that the true tadpoles of *Nyctibatrachus* resemble those of *R. semipalmata* in having no horny teeth on the mouth-disk. Unfortunately, he never described these *Nyctibatrachus* tadpoles afterwards.

Rao (1920) recorded the spawning of *R. leptodactyla* from Coorg and described its life history by rearing up the larvae with horny teeth up to two-legged stage. It may, however, be remarked that

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* Numbers marked with an asterisk, were examined by Dr. Bhaduri at Bombay.

Annandale (1918, p. 20) relied for the identification of the tadpoles of *R. leptodactyla* on rather circumstantial evidence and on their apparent resemblances with those of *R. semipalmata*. Rao is, therefore, quite right in pointing out that tadpoles described by Annandale as *R. leptadactyla* do not belong to that species and may prove to be one of the species of the genus *Nyctibatrachus*.

So far only the tadpoles of *N. sanctipalustris* have been described from the hill-streams of Hebbe and Huthode (Kadur, Mysore) at an elevation of 4,000 ft., by Rao in 1920. These tadpoles are very much different from those of *N. humayuni* in possessing the labial teeth rows with the formula, 1 : 1—1/3. *N. humayuni* tadpoles as recorded above are devoid of any labial teeth rows, and they bear a close resemblance to Annandale's *R. leptodactyla* tadpoles.

ACKNOWLEDGEMENT

We take this opportunity to record our sincere thanks to Mr. H. Abdulali and Dr. H. W. Parker for helping us in various ways in this study. Our thanks are also due to Sri Subodh Mandal and Sri R. C. Bagchi for the illustrations in the accompanying plate.

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FIELD NOTES ON THE WRINKLED FROG

On August 9, 1953, while looking for frogs and fish in a rocky monsoon stream at Culvert 413, half way up the ghat between Khopoli and Khandala (*ca.* 1,500 ft.), I saw a large frog seated on a flat rock covered with algae and wetted by the flowing water. During my attempts to catch it, the frog was twice washed into the stream, but it immediately landed on the nearest rock and then sat still, not unlike a toad. In the hand, however, the disks on the fingers and toes were noticeable and the vertical pupil was also distinctive (after one's attention had been drawn to it !). Tadpoles, apparently of this species, were also found at the bottom of a pool formed by an eddy about 20 yards downstream. Though several were seen, they were not very numerous and gave no suggestion of living together in shoals as is common with some other species. The small loach—*Nemachilus evezardi* was present in an adjoining, but not in the same pool.

Another visit on the night of August 30th and the following morning produced two more frogs and some tadpoles distributed over small pools in the same stream. On no occasion were more than six to eight tadpoles seen together in the same pool and these were also in different stages of metamorphosis. Later in the year the stream was completely dry.

On 18th July 1954, at Khandala, I again saw some adults in the same stream, and on 29th August noted tadpoles of varying sizes in the Waghdhondi stream near the Kathori village between the Khandala Hotel and Duke's Nose, and also in a small pool in a stream hardly more than a trickle, under the hills known as 'The Sausages'.

Only a solitary tadpole was noticed when I visited Culvert 413 with Dr. Bhaduri on 7th September. The assumption that heavy rains had then driven them into refuge is substantiated by the abundance of tadpoles in the same stream on 21st September. By 30th October the stream was almost dry and none were seen.

From 19th to 25th October 1953 I had the opportunity of visiting the Devimani and Bundel Ghats near Sirsi, in North Kanara, and obtained many tadpoles under similar conditions. No adults were obtained. Mr. Dinsha Panday then obtained some further specimens of this frog from Mahableshwar together with tadpoles.

Tadpoles and frogs were also seen in a stream flowing into Simpson's Tank at Matheran on 18th October, 1954.

The tadpoles though always found in pools in, or linked with, running streams always stay at the bottom in the relatively quiet water, which was seldom more than a few inches deep. They are not very agile, and when disturbed will take refuge under overhanging rocks and stay there for some time.

Messrs. Daniel and Chari of the Prince of Wales Museum visited Mahableshwar on 10th December 1954 and saw large numbers of these tadpoles of different sizes. Tadpoles have now been noted between 9th August 1953 (Khandala) and 10th December which indicates either a long period of metamorphosis or a prolonged breeding season, both of which again might be variable.

Early in November 1954 I was at Mahableshwar, and in the streams where we had drawn a blank earlier with Dr. Bhaduri, considerable numbers of adults and tadpoles in all stages were seen. From my previous notes I had put this frog down as a diurnal species, but a stream on the Fitzgerald Ghat was visited at night and much larger numbers seen, than during daytime. Several were squatted in the spray of falling water and others attached to vertical sides of rock pools with the lower half of the body in water. In the same facies, but almost invariably out of water, were a large number of *Rana beddomii* and *R. temporalis*.

In colour, the adult Wrinkled Frogs were usually uniform blackish-grey above, this colour extending towards the under-side of the legs and body and gradually paling into white on the belly. The chin and throat were dark—almost as dark as the back. The upper surface is irregularly wrinkled and granulated with almost wartlike excrescences on the hind legs. This character distinguishes it from all other frogs of the neighbourhood, and I have therefore proposed 'The Wrinkled Frog' as an appropriate name for the species. A female collected in August 1953 had a patch of yellow on the undersurface of the femur near the anus, the colour extending halfway towards the knee. Another taken on 18th July 1954 had a similar patch which was noted as orangeyellow, but this specimen was unfortunately not sexed.

Occasional individuals, including a 1-in. frog, had tinges of brick-red on the head. The tadpoles were of a dark olive-green colour but with the tail mottled on a paler background.

On 18th July three individuals, about 1½ in. in length, were seen in the Khandala stream under Culvert 413. They were in flowing water, resting against the vertical wall of the culvert with their heads just out of water; if splashed they worked their way higher up on the wall (individuals in captivity can stick against vertical glass surfaces). About 18 in. above them were two small rectangular patches of eggs about 2 × 3 in. and about ¼ in. thickness (this would also be the diameter of each egg) stuck against the vertical wall. It is possible that these were the eggs of this species.

The stomachs of a few individuals examined contained Mayflies (*Heptagenia* sp.) in nymphal stages, water beetles (*Sphaeroderma* sp.) a Lycosid spider, remains of several insects and bits of the tape-like bryophytic weed (*Aspermytes khandalensis*), and an entire crab.

H.A.

IXODES KERRI, A NEW SPECIES OF TICK FROM A FLYING SQUIRREL FROM SOUTHERN INDIA (ACARINA: IXODIDAE)

BY

T. RAMACHANDRA RAO, D.SC.

Virus Research Centre, Poona, India[1]

(*With two plates*)

Sharif (1928), in his revision of Ixodidae of India, recorded four species of ticks of the genus *Ixodes* as occurring in the country. The species mentioned by him and their recorded hosts and distribution in India are:

SPECIES	HOSTS	DISTRIBUTION
Ixodes ricinus (Linnaeus, 1758)	Dogs and sheep.	Kashmir and Kangra Valley.
I. acutitarsus (Karsch, 1880)	Ox.	Miri Hills, Assam, and Darjeeling District, Bengal.
I. granulatus Supino, 1897	*Epimys* (=*Rattus*) *rufescens* Gray, *Sciurus* (=*Callosciurus*) *erythraeus intermedius* Anderson, and 'Squirrel'.	Darjeeling District, Bengal, and Abor Country and Naga Hills, Assam.
I. holocyclus Neumann, 1899	'Red Squirrel' and '*Sciurus variabilis*'.	Unknown.

I. holocyclus is known in India only from nymphs and its hosts are as recorded by Nuttall *et al.*, (1911). In addition, Sen (1938) has mentioned that *Ixodes japonensis* Neumann, 1904, has been collected from a Barking Deer, *Cervulus aureus* (sic) at Mukteswar in Kumaun Hills, Uttar Pradesh. [*Cervulus aureus* (=*Muntiacus muntjak aureus* Smith) however, is the Barking Deer of southern India and that in Kumaun Hills is probably *Muntiacus muntjak vaginalis* Boddaert]. All the known localities mentioned above are either in the Himalayas or in the mountains of Assam.

More recently, Kohls (1947) has added one more species to the list: *I. radfordi* Kohls, 1947, on *Rattus rattus rufescens* Gray, from Imphal, Manipur, eastern India. He has also described another closely related species from Uva Province, Ceylon: *I. ceylonensis* Kohls, 1950, on the mongoose, *Herpestes smithii zeylanicus* Thomas and on *Rattus rattus kandianus* Kelaart.

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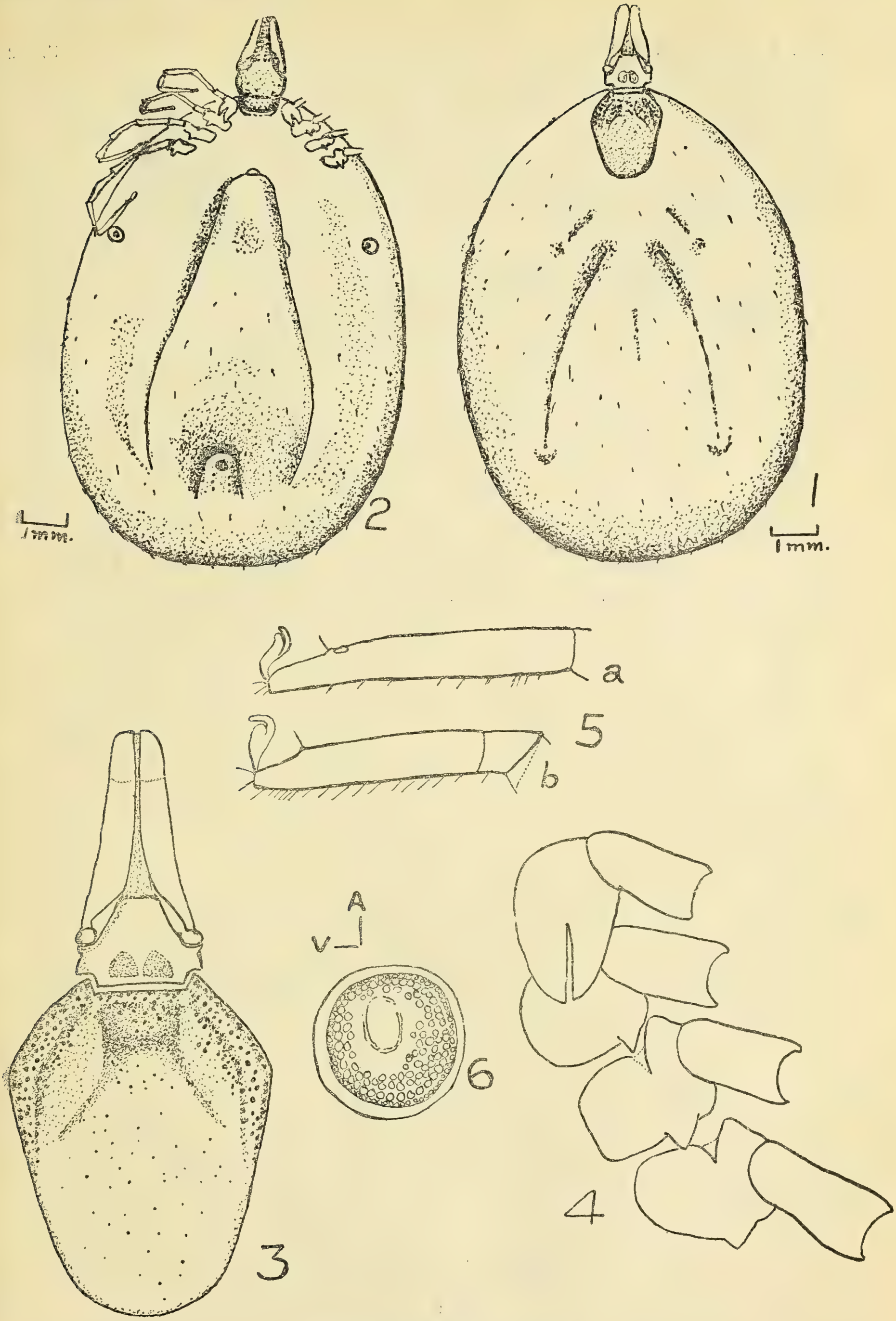
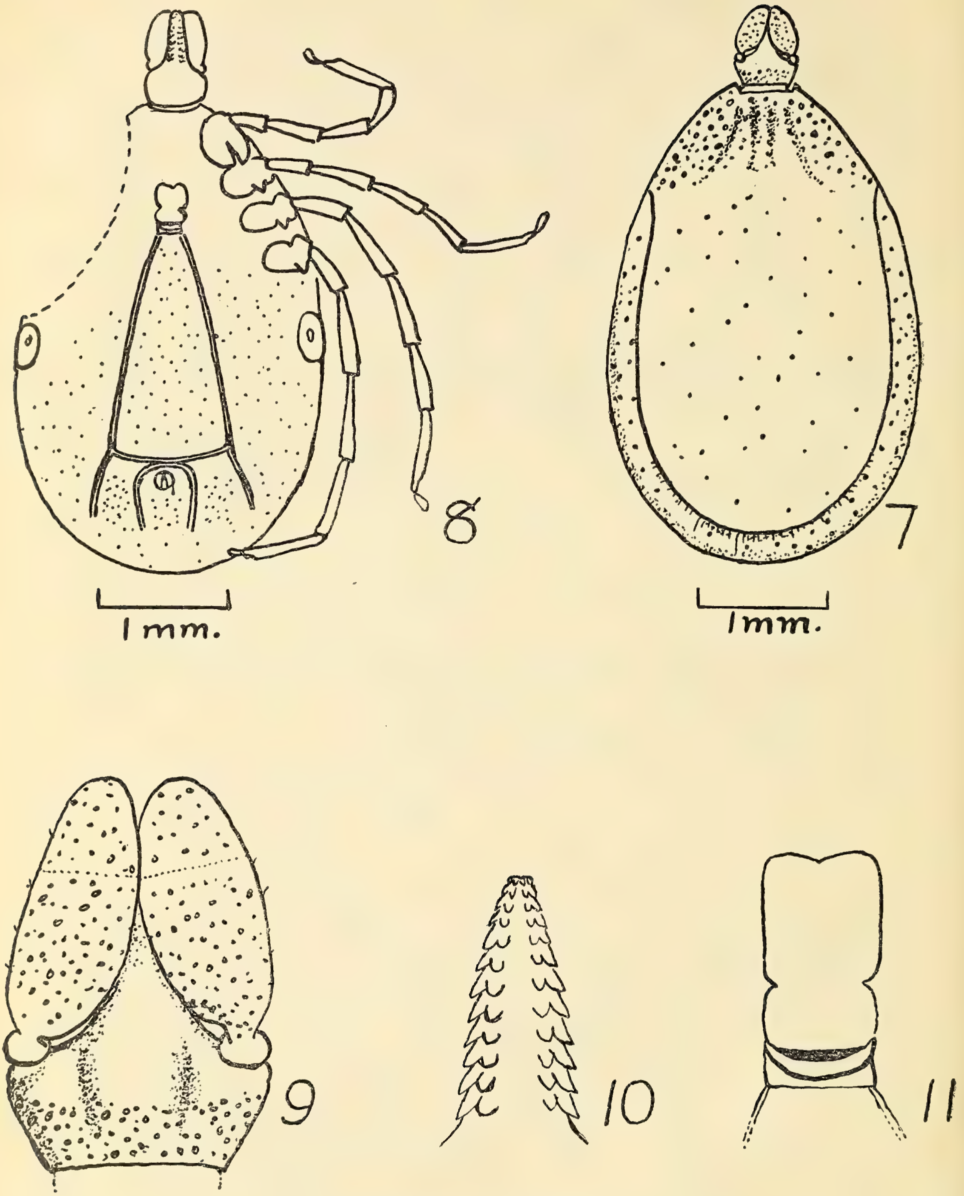
[1] The Virus Research Centre, Poona, has been established by the Indian Council of Medical Research with the cooperation of the Division of Medicine and Public Health of the Rockefeller Foundation, and the Government of Bombay.



Ixodes kerri, new species

FEMALE

FIGS. 1-6 : 1. Dorsal view. 2. Ventral view. 3. Scutum and capitulum. 4. Coxal armature. 5. Tarsus ; (*a*) : leg I ; (*b*) : leg IV. 6. Spiracle ; A = anterior ; V = ventral.



Ixodes kerri, new species

MALE

FIGS. 7-11 : 7. Dorsal view. 8. Ventral view. 9. Capitulum, dorsal view. 10. Hypostome, ventral view. 11. Pregenital plate, genital aperture and post-genital plate.

The genus *Ixodes* has so far not been reported from anywhere else in India. The Director of the Zoological Survey of India, Calcutta, informed the writer in March 1954 that there was no specimen of *Ixodes* from southern India in the collections at the Indian Museum. Therefore the finding of ticks belonging to this genus in southern India at a place about 300 miles south of Bombay is of considerable interest.

Two females and one male tick were collected from a Large Brown Flying Squirrel, *Petaurista petaurista philippensis* Elliot, 1839, on February 3, 1954 in the heavy rain forest of Kasgi Village, Sirsi Taluka, Kanara District, Bombay State (Lat. 14° 26′ N.; Long. 74° 39′ E.) at an elevation of approximately 1,450 ft. above sea level. The squirrel was one of two shot by Mr. B. S. Lamba as they came out of a tree-hole, after being disturbed. Mr. P. K. Rajagopalan and Mr. S. L. Naik made the following notes when they removed the ticks from the squirrel: 'The females were attached to the base of each ear of the squirrel. The male was attached to the body of one of the females, probably in copulation.' From the two squirrels 35 mites of the family Laelaptidae were also collected.

The specimens differ from all the other species of the genus recorded in India. The points of difference from the other species are:

From *I. ricinus*: Size large; coxa I with two large subequal spurs.

I. acutitarsus: Coxae II to IV with only one spur each; anal groove of male slightly convergent behind; scutum of female distinctly longer than broad; genital aperture of female distinctly posterior to a line connecting coxae IV.

I. granulatus: Coxa I with two large spurs; fine punctations on the scutum few and sparsely scattered in the median field; palpal article II more than twice as long as article III. (See addendum.)

I. holocyclus: Coxa I with two spurs; anal groove of female open behind; pregenital plate of male longer than broad.

I. radfordi: Coxa I with two spurs and the single spurs on other coxae prominent; a few fine punctations in the posterior area on the scutum of the female, but no large punctations in that area.

I. japonensis: Coxa I with two large spurs and coxae II to IV with single prominent spurs.

They are also clearly distinguished from *I. ceylonensis* in the coxal armature, though in size there is some resemblance. In the size they also resemble *I. gigas* Warburton, 1910, a species which Sharif considers as a synonym of *acutitarsus*. On referring to Nuttall *et al.* (1911) several points of difference from *gigas* also were noticed, and among them were the presence of fine punctations all over the male scutum, the anal grooves slightly converging behind and spiracles being circular and not oval. They do not agree with any of the other 50 species of *Ixodes* described by Nuttall *et al.* (loc. cit.).

The ticks are obviously new and the writer has much pleasure in naming them *Ixodes kerri*, after Dr. J. Austin Kerr of the Division of Medicine and Public Health of the Rockefeller Foundation, who has been greatly responsible for stimulating the writer's interest in acarology.

Ixodes kerri, new species

DESCRIPTION

FEMALE (Figs. 1-6). Two engorged specimens only.

Length of body including capitulum, 12 and 13.5 mm.; width of body, 8.0 and 8.5 mm.

Color: Chestnut brown, scutum darker.

Dorsum: Surface finely striated and slightly hairy. Two prominent internal accessory grooves.

Scutum: Longer than broad, length 2.6 mm. and width 2.0 mm. Coarse punctations abundant in the lateral and cervical fields, and absent in the posterior two-thirds of the median field. Fine punctations numerous in the anterior part of the median field but few and scattered in the posterior part.

Venter: Surface finely striated and slightly hairy; genital aperture slightly posterior to a line connecting the coxae IV. Genital grooves extend posteriorly to beyond the level of the anus. Posterior limbs of anal groove slightly divergent.

Legs: Long and moderate in size. Tarsi rather abruptly narrowed subapically.

Coxal armature: All coxae flattened. Coxa I with two well-developed nearly equal, flat, pointed spurs which slightly overlap coxa II. Coxae II to IV each with one short but prominent spur on the posterior margin. Coxae II to IV with slightly salient posterior borders. Coxae III to IV with prominent spurlike projection on the antero-lateral aspect. The margins of coxae shaded dark.

Spiracles: Almost circular.

Capitulum: About 2½ times as long as broad. Base slightly broader than long. Porose areas roughly triangular in outline, large, slightly depressed and set close together, the interval between the two at the base being less than a quarter of the width of either. .Palps slender and four and a half times as long as broad; outer border nearly straight with some indication of concavity but inner border convex. Article I visible both dorsally and ventrally. Article II about three times as long as III. Hypostome more pointed than in male and with rows of 2/2 teeth and about 12 teeth in each row.

MALE (Figs. 7-11). One specimen only.

Length of body including capitulum, 4.5 mm.; width 2.5 mm. Shape suboval.

Color: Chestnut brown, scutum darker; median ventral plate lighter.

Scutum: Smooth, with fine punctations sparsely scattered all over and the larger punctations abundant in the anterior region. Cervical grooves shallow and slightly divergent.

Venter: Median plate with fine punctations scattered all over, each punctation with a short delicate hair. Genital aperture between coxae III. Pregenital plate longer than broad, slightly constricted at about its posterior third and slightly indented in front. Post-genital plate exhibits the usual transverse crescentic chitinisation. Anal groove horse-shoe shaped with the posterior limbs slightly converging behind but not meeting each other. Entire ventral surface with punctations.

Legs and coxal armature: As in the female.

Spiracles: Almost circular.

Capitulum: Base roughly pentagonal in shape, the lateral margins slightly converging posteriorly; about 1½ times as broad as long; posterior half of the dorsal aspect covered with numerous coarse punctations. Palps about three times as long as broad, covered with coarse punctations and fine scattered hairs; article II about 1½ times as long as III; article IV very small and bears 16-18 sensory hairs on tip. Hypostome has 2/2 rows of teeth about 12 in each row.

Material: One male and two females collected from a large Brown Flying Squirrel, *Petaurista petaurista philippensis* Elliot, 1839, taken at Kasgi, Sirsi Taluka, Kanara District, Bombay State, India.

Date: February 3, 1954. Preserved in 75% alcohol.

Holotype: One male; Allotype: One female. Deposited in the Indian Museum, Calcutta. Reg. Nos. 2392/18 and 2393/18 respectively.

Paratype: One female only in the collections of the Virus Research Centre, Poona, India. (No. A-1193.)

SUMMARY

Ixodes kerri n. sp. from the Flying Squirrel, *Petaurista petaurista philippensis* Elliot, 1839, from Kanara District, Bombay State, India, is described. This is the first record of any *Ixodes* from India south of the Himalayas.

ACKNOWLEDGEMENTS

The author is grateful to Dr. H. Hoogstraal, U.S. Naval Medical Research Unit No. 3, Egypt, for kindly examining the specimens and confirming the author's opinion that the tick belongs to a new species.

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ADDENDUM

After the above paper went to press Dr. G. N. Kohls, Rocky Mountain Laboratory, Hamilton, Montana, USA, has drawn the attention of the author to a few points and made a few valuable suggestions. They will be briefly referred to here.

1. '*I. kempi* Nuttall 1913, synonymised by Sharif (1928) under *I. granulatus* is regarded by Anostos [Anostos, George, 1950, The scutate ticks, or Ixodidae, of Indonesia, *Entomologica Americana*, 30 (1-4): 1-144] as a valid species.'

If this is confirmed *I. kempi* would be the seventh species of the genus already recorded from India.

2. 'The shape of the female basis capitulum posterolaterally and the armature of coxa I in both sexes, as figured, are most unusual and if both these features are actually as illustrated they deserve emphasis in the text.'

The features have been reexamined. The posterolateral margin of the female basis capitulum is as illustrated and has a distinct concavity. The armature of coxa I is also as delineated. The two spurs are flat, broad, set close together and nearly equal, the outer one being a shade smaller. In the published illustrations of the other Indian species of *Ixodes* with two spurs on coxa I, the spurs are shown narrower, more pointed, more unequal and set more apart. The anteromedial margin of the coxa I in the female, however, should have been delineated less rounded and with a slight concavity.

The author's sincere thanks are due to Dr. Kohls for the very constructive suggestions made by him.

WILD LIFE PRESERVATION IN INDIA

ANNUAL REPORT FOR 1953 ON THE WESTERN REGION[1]

BY

K. S. DHARMAKUMARSINHJI
Vice-Chairman, Indian Board for Wild Life and Honorary Regional Secretary

A brief summary of the wild life situation within my region is necessary. The position of wild life exclusive of game species appears to be satisfactory. Big game species on the whole, are on the decrease, and certain species such as Lion, Blackbuck, Chinkara, Swamp Deer, and perhaps Sambar with their respective habitats require special protection. The Crocodiles (two species—*palustris* and *Gavialis gangeticus*) are definitely diminishing in numbers and therefore need discreet protection. Small game in general, is not yet seriously affected; in some States it is on the increase. But the Great Indian Bustard (*Choriotis nigriceps*) and Jungle-fowls (red and grey), require careful preservation.

The formation of State Wild Life Advisory Boards has had a beneficial effect on the general public and State Departments all over, and has done much to save the wild life of Western India. The Wild Animals and Wild Birds Protection Acts in the States of Bombay and Saurashtra are certainly welcome and there is a growing sympathy by the people towards the preservation of wild life, in the two States. However, 'Touring Wild Life Committees' are essential to estimate and evaluate wild life populations 'on the spot'. Schemes for National Parks are rapidly gaining strength. 'Protected Areas' for wild life are being established. More attention is being given to Sanctuaries.

Fish life during drought years have suffered heavily in some States, but fish depletion in the larger rivers has not taken place. The freshwater fish industry needs special attention.

This report has been prepared from information received from various States, and includes a rapid survey of the Gir Forest in Saurashtra, the home of the Indian Lion.

The Indian Board for Wild Life at its Mysore Conference of November 1952, prepared excellent recommendations for the Government of India, Ministry of Food and Agriculture, so that the Government of India could assist all States to protect their diminishing wild life assets. And also, the Government of India wrote to all State Governments advising them to set up Wild Life Advisory Boards. My reminder dated 5-2-1954 to all States in the Western Zone, emphasized the need to set up these Boards early. The following States responded: Bombay, Saurashtra and Madhya Bharat.

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[1] The Western Region covers the following States : Bombay, Saurashtra, Rajasthan, Madhya Bharat, Madhya Pradesh, Vindhya Pradesh, Bhopal, Ajmer and Kutch.

The Saurashtra State, in particular, has made rapid progress and has held two meetings of the State Wild Life advisory Board, on 30-10-1953 and 5-1-1954. At the second meeting, some very critical recommendations to improve the existing Saurashtra Wild Animals and Wild Birds Protection Act, 1952, which was in truth, a copy of the Bombay Wild Animals and Wild Birds Protection Act, 1951, were made, according to local conditions and needs. The following were the principal resolutions[1] passed by the State Board, most of which were accepted by the State Government.

(1) Creation of a National Park in the Gir Forest to protect the Indian Lion and other game species.
(2) Amendments to the Saurashtra Wild Animals and Wild Birds Protection Act, 1952.
(3) Complete protection of certain wild life species and the establishment of 'Protected Areas'.
(4) Enforcement of the Saurashtra Wild Life Act.
(5) Publicity for wild life preservation.
(6) 'Close Seasons'.
(7) Honorary Game Wardens.

On the whole the setting up of State Wild Life Advisory Boards has been quite a slow process except for States such as Bombay and Saurashtra. It is a pity that the remaining States have not fallen in line. However, Rajasthan, Madhya Pradesh and Vindhya Pradesh are preparing to do so.

The following States have suitable Wild Life Acts: Bombay, Saurashtra, Bhopal and Madhya Bharat. Rajasthan, Vindhya Pradesh and a few others have prepared or are preparing Bills for the same. The progress is slow.

POSITION OF WILD LIFE

The position of wild life within the region cannot be accurately estimated without a proper survey. Replies received to my circular letter inquiring of the position of wild life from the States are favourable except for the big game population. In general, it appears that big game is not in abundance anywhere and that reduction of game species continues.

Bombay: The wild life of the State is well protected and has commenced to increase. A Wild Life Preservation Officer is appointed by the State Government to look after the affairs of preservation of wild life in the State.

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[1] Almost all the resolutions were moved by K. S. Dharmakumarsinhji as the representative of the Inspector-General of Forests, Central Government.

Saurashtra: The Victoria Park at Bhavnagar, which has been a 'Peoples Park' for over 60 years, contains a variety of wild life such as, Blackbuck (*Antilope cervicapra*), Cheetal (*Axis axis*), Nilgai (*Boselaphus tragocamellus*), Wild Pig (*Sus cristatus*) and small game, apart from the variety of bird life. The Forest Department has started to care for wild life preservation within the Park limits. A census taken by me of the big game resulted as follows:

	25	Nilgai
	16	Blackbuck
	78	Wild Pig
	21	Cheetal
Total	140	heads

The area consists of thorny scrub and is about 6 square miles. Formerly, it used to contain species like, Chinkara (*Gazella bennetti*), Hog Deer (*Axis porcinus*) and Sambar (*Rusa unicolor*). The Spur-fowl (*Galloperdix spadicea*) was successfully introduced in the past.

The Divisional Forest Officer's report from Jamnagar states that game species are increasing in the Gir Forest and Barda Hills and decreasing in other parts of Saurashtra. My rapid survey of wild life of the Gir Forest between 1st April and 15th April, failed to reveal game in abundance, while actually some species were found in small numbers and are obviously reduced.

The Indian lion is one of the most important animal species in Asia today, the preservation of which has drawn the attention of the International Union for the Protection of Nature. My report of 1949 to the Union referred to this problem. The Asiatic Lion (*Panthera leo persica*) formerly ranged throughout the Middle East and northern India. Today, it is restricted to the Gir Forest in Saurashtra and Bombay (Amreli District—formerly Baroda territory). The Saurashtra Government has given protection to the animal by order Notification No. DP/F/III8-7/157 dated 25th July 1953 and by Section 16 of the Saurashtra Wild Animals and Wild Birds Protection Act, 1952; and the Bombay State has given the lion complete protection. The lion census made by Mr. M. A. Wynter-Blyth in 1950 on behalf of the Saurashtra Government revealed between 219 to 227 lions (adult and young inclusive) with a maximum of 250 lions in the whole of the Gir Forest. The killing of lions is carefully controlled by the Rajpramukh of Saurashtra and the limit of four lions to be shot per annum has been laid down as a general policy. This seems to be reasonable in spite of the fact that lions may increase rapidly if given proper protection. The State Wild Life Board, at its second meeting recommended 3 lions and 3 lionesses to be shot as maximum for the whole year. However, lions have been ordered to be destroyed for cattle-lifting from time to time and it is unfortunate that a number have been thus killed. Moreover, an accurate record of lions destroyed or found dead has not been kept by the Forest Department. It appears that a good number of lions have been destroyed in a clandestine manner. Actually, I feel that on no account should lions be killed for cattle-lifting since most lions in the Gir Forest, at one time or another, feed upon cattle owing to the density of livestock within the Forest. It is deplorable that records of game killed in the Gir Forest, as well as in areas in some other States, have not been accurately maintained, and in a few are even completely wanting. My recent survey of the Gir Forest revealed that game had been indiscriminately shot, especially Cheetal, Wild Boar, and Sambar, while Chousingha and Nilgai were holding their own in fair numbers, though not in abundance. It is unfortunate that the wild life of the Gir area has not had the rigid protection as made known officially in spite of the importance of the lion. The Grey Hornbill (*Tockus birostris*) appears now to be extinct. The Green Pigeon (*Crocopus phoenicopterus*) may have the same fate due to carelessness if not well protected, for the feathers are sought for the same medicinal purpose as those of the Grey Hornbill. During my rapid survey, firing was heard within the Gir Forest and animal life was seen to flee at the approach of motor vehicles. This behaviour of game species discloses indiscriminate shooting from motor vehicles in contravention of Section 17 of the Saurashtra Wild Animals and Wild Birds Protection Act, 1952. The State Government has appointed a Wild Life Officer for the Gir with a small staff. This so-called Wild Life Department enjoys a reputation of supplying shikar to some sportsmen only. The present set-up is wholly unsatisfactory since poaching is rampant, mostly by forest contractors and their workmen. The Forest Department is ignorant of how to manage wild life in the Gir. The sooner a National Park is formed in the Gir, the better it will be in the interest of the lion. The lion's natural food is slowly decreasing, and unless firm steps are taken to prevent the killing of game species which supply its food, a crisis is inevitable. The State Government should keep a proper record of the lions and game killed or found dead, and this information should be passed on to the Regional Secretary for Wild Life regularly every month.

The present question of controlling the *maldharies*—livestock owners—in the Gir Forest is under the consideration of the Saurashtra Government. The Forest Minister, Shri Dayashanker Dave, and Shrimati Pushpaben Mehta (who is appointed on a special committee to study this problem) have taken special interest in the plan for the rehabilitation of *maldharies*. This is, I believe, an excellent plan, for it will seclude *maldharies* and afford them greater safety from the lion, and also give the lion and its habitat rest and relief. Incidentally, the State Government is also planning to have a National Park in the Gir. The advice of the Regional Secretary has been invited in this connection, and a suggestion to set aside at least 350 square miles of forest land for a National Park has been made. This will allow sufficient areas free for cattle grazing and afford Buffer or Preservation zones for the benefit of sportsmen.

Grassland Habitat: Grassland without mixed deciduous forest canopy comprises ideal habitat for Nilgai, Blackbuck, Chinkara, Bustard and small game. The grass and bushy cover supply them with food and shelter. Since the tendency to plough grasslands has grown, and owing to the encroachment of livestock upon grassland, the above species and their habitat are threatened. Again, owing to the ease with which these 'lowland' game animals are killed, they are decreasing at an alarming rate, in spite of the existing laws and regulations giving them protection.

It is evident that game species such as Blackbuck and Chinkara have been reduced to danger point in Saurashtra State. And this may well apply also to other States within the zone. It means that unless these species are given adequate protection, they are open to the hazards of extirpation. As for forest land, the game within is comparatively less reduced but is nowhere in abundance. In my report of the rapid survey of wild life and game, 1950, in the States of Rajasthan, Madhya Bharat, and Saurashtra, which are now within my region, I had emphasized upon the need for protecting wild life and game and left no stone unturned in advising and supplying the States with useful information on National Parks, Sanctuaries, Wild Life Boards and Wild Life Department, etc., etc. Since then very little progress has been made, apart from what has been done by the Bombay and Saurashtra States. It is unfortunate that the Rajpramukhs and their Governments have neglected the subject of Wild Life Preservation.

Rajasthan: The Keoladeo Ghana at Bharatpur, proposed as a National Bird Sanctuary, was completely neglected, until a special directive from our Prime Minister Shri Nehru was sent. It is now hoped, that during the coming season the nesting of water birds and wintering of migratory wildfowl will be a success. This is a place which will attract bird-lovers from all over the world.

Siraska in Alwar, Sawai Madhopur in Jaipur, Jayasamand in Udaipur and certain areas close to the Chambal in Kotah, should be carefully re-surveyed for future wild life projects. Crocodiles in the rivers of Rajasthan have been depleted and so require special protection. The Ban-Bihar Game Preserve at Dholpur is a place where wild animals can be seen at close quarters.

Madhya Bharat: The State has excellent Sanctuaries: Shivpuri, Barwaha, and Bhanpura. Game species like, Tiger, Leopard, Sambar, Cheetal, Four-horned Antelope and Sloth Bear (*Melursus ursinus*), can be seen at their best in these areas. The Madhya Bharat Wild Life Act is excellent and enforcement of the same is being carried out in the normal way. Honorary game wardens should be appointed in large numbers for the whole of the State, if game preservation is to be effective. A report from the Chief Conservator of Forests indicates, that wild life is being adequately protected and yet poaching by persons in motor cars takes place sufficiently to affect the wild life population. It is indeed alarming to receive reports of this nature, especially when the Forest Department itself admits that the wild life on the whole is decreasing. Consequently, immediate steps should be taken to lessen poaching by motorists.

The record of big game shot per annum during the last three years in the State, furnished by the Forest Department, is given below:—

Northern Circle	1951–2	1952–3	1953–4
1. Gwalior Div.	4	9	—
2. Sheopur ,, ...	62	11	4
3. Shivpuri ,, ...	5	—	43
4. Guna ,, ...	2	—	11
	73	20	58
Southern Circle			
5. Nemawar Div.	—	7	55
6. Dhar ,, ...	—	—	—
7. Nimad ,, ...	15	13	—
8. Indore ,, ...	5	5	5
	20	25	60
Grand Total ...	93	45	118

Strangely enough the above report does not give the names of species killed!

Madhya Pradesh: The wild life of Madhya Pradesh is unique and the State contains the following important large game species. Tiger (*Panthera tigris*), Swamp Deer (*Rucervus duvaucelli*), Buffalo (*Bubalus bubalis*), Gaur (*Bibos gaurus*), Cheetal (*Axis axis*), Sambar (*Rusa unicolor*), Blackbuck (*Antilope cervicapra*), Chinkara (*Gazella bennetti*), Chousingha (*Tetraceros quadricornis*), Barking Deer (*Muntiacus muntjac*), Leopard (*Panthera pardus*). The Forest Department is taking keen interest in preserving these animals. The meeting of the Executive Committee of the Indian Board for Wild Life held at Kanha, Banjar Game Reserve last October (1953) had a great stimulating effect on the people and the State Forest Department, and the presence of the Union Minister, Dr. Punjabrao Deshmukh, and State Forest Minister at the meeting was cordially welcomed. Future National Parks are being planned. Areas in the old Bastar State have great wild life potential. The best areas are in fact Nature Reserves which could be turned into National Parks or Sanctuaries where historical places and the wild life characteristic of the State could be viewed in almost luxury.

Vindhya Pradesh: The State has preserved much of its wild life in spite of the need for scientific wild life management. Reports indicate that there are no special problems affecting wild life. The State Wild Life Board is being set up.

Ajmer: The position of wild life preservation in the State is unsatisfactory and a special inquiry committee should be appointed immediately to go into the matter.

Kutch: The vast dry area of Kutch lends itself ideally for wild life preservation, though game species are on the decrease at present owing to military occupation and general lack of interest. Special measures to protect the Great Indian Bustard (*Choriotis nigriceps*) should be taken.

Kutch is famous for the breeding place of the Flamingo (*Phoenicopterus ruber antiquorum*) the only place where these birds are found nesting in India. Because of the inaccessibility of the site of the breeding colony, the species is well protected naturally. Any special measures to afford the nesting area greater protection by artificial means would probably endanger the birds' breeding. Flamingo prefer complete seclusion from human interference and this is what they already have in Kutch. Kutch also contains the Onager or Wild Ass (*Equus hemionus khur*). These animals are found in fairly large numbers and their range reaches the borders of Northern Saurashtra. At present, the species is well protected.

Bhopal: The Bhopal State has been fortunate in having proper regulations governing its wild life policy. I am glad to state that, the game preserves there, seem to be well managed on the whole, although, game of the larger kinds may not be as numerous as in the past. The preservation and shooting of wild life in Bhopal is regulated under the Bhopal Wild Animals and Wild Birds Protection Act No. 311 of 1930 and various notifications issued thereunder and the revised shooting rules of 1951.

In all respects, Bhopal offers good shooting to sportsmen with camera or rifle, as it contains almost all game species, both large and small, such as are usually found on the Malwa Plateau. The total area of Reserved Forest is about 1,254 square miles, which is divided into two divisions, Eastern and Western, with areas of 657 and 597 square miles respectively.

ASSESSMENT OF THE EFFECTIVENESS OF EXISTING LEGISLATION

Bombay and Saurashtra have, as mentioned earlier, made their own Wild Life Acts known as the Bombay Wild Animals and Wild Birds Protection Act, 1951 and the Saurashtra Wild Animals and Wild Birds Protection Act XXXII of 1952. The Saurashtra Act has been amended as advised by the State Wild Life Advisory Board. This will make the Act one of the best in India. The State Board in its second meeting have recommended 'Protected Areas' for saving Chinkara and Blackbuck especially, and each district will have two such areas each for the safety of the species. The Grey Hornbill has been declared a protected bird; but I fear that this measure is too late. The same might be said in the case of the Great Indian Bustard; however, some birds are still to be seen. In the Saurashtra Wild Animals and Wild Birds Act, the word 'Natural' (Kill) in Section 17 has been removed; and certain Sections irrelevant to local conditions have also been eliminated, e.g., 41, 42, 43 as they refer to ivory of Elephants. Moreover, Sloth Bears, Tigers and Barking Deer have been deleted from Schedule No. II and III, as these animals are not found in Saurashtra. The Act is excellent but the enforcement appears to be lacking. There are no restrictions on the movements of nomadic tribes, who cause havoc to wild life. However, it is gratifying to state that partridges and resident waterfowl are on the increase, while the hare is definitely on the decrease. Strict measures by the Bombay State are being enforced by the Wild Life Preservation Officer and poaching of game species is being checked. Co-operation by Honorary Game Wardens is forthcoming. In order that the law be enforced effectively, State departments such as Police, Forest and Revenue should take a keener interest in seeing that regulations like Close Season, etc., are observed. The Military, particularly, are the greatest offenders of shooting regulations and certain areas of wild life abundance have been completely ruined by them.

If any Wild Life Act is to be effective, the magistrates and judicial councillors should fully understand and realise the importance of wild life as a National Asset and law-breakers should be heavily punished. From information gathered from various States, it appears that there is not enough co-operation from State Departments or from the public for stamping out indiscriminate killing of game and for enforcing the existing laws pertaining to wild life protection. In view of this, it can be said that in most States game, on the whole, is decreasing in spite of legislation and rules and regulations prohibiting unlawful killing of wild life. In the Saurashtra Wild Animals and Wild Birds Protection Act, 1952, Section 50 (1) reads as follows:—

'Defence of life and property. Subject to the provisions of Sections 38 to 40 (both inclusive) nothing in this Act shall prohibit the killing or capturing of any wild animal or wild bird by the occupier of any land in defence of the standing crops or cattle on the land.'

Many lions are shot and wounded under this Section of which little is known. There is no doubt that exception should be made in the case of rare animal life, such as the Indian lion, if the species is to be saved.

Sanctuaries in the States have not been effectively managed and wild life is being killed at a rapid rate. It is therefore, of vital importance that the Government of India should nominate Committees consisting of experts to tour all States to see for themselves the position of wild life population and then advise the States on how to manage their wild life resources. These Touring Committees would organise, where necessary, 'Game Censuses', so as to estimate the density of game population. I strongly emphasize the importance of having Touring Committees, which may actually see or investigate on the spot how wild life is managed, and whether it is given the necessary protection or not.

In Saurashtra, by individual effort a series of 16 mm. colour films depicting wild life in natural surroundings have been produced to inculcate interest in the public towards wild life preservation.

In spite of repeated warnings of wild life depletion the progress made for protecting game species has been painfully slow, and in some cases much too late. However, if even now other States were to follow in the footsteps of Bombay and Saurashtra, they would gain considerably in protecting their wild life before it vanishes completely. I have come to the conclusion that, it is essential for the States to inaugurate 'Protected Areas' where Sanctuaries in the strict sense, cannot be established, as early as possible and, with the aid of the Central Government, create National Parks immediately.

In the interests of State Governments to ensure that their wild life is adequately protected and that areas of Sanctuaries or Preserves are being managed satisfactorily, I even suggest District Wild Life Committees, consisting of the following persons: Collector, District Superintendent of Police, Divisional Forest Officer and one unofficial Honorary Game Warden. This team could tour important areas together and assess the wild life population of the district, from time to time. There is no doubt that this sort of committee would create much interest in the public as well as gain knowledge of local wild life conditions. So far, much of the effective steps to protect wild life have been taken on paper and few persons really know the actual position of game and wild life population in the States. If this is to be achieved, then, the answer I believe is in forming 'Touring Wild Life Committees' appointed by the States and by the centre.

HABITS AND HABITAT OF SOME COMMON SPIDERS FOUND IN WESTERN INDIA

BY

T. V. SUBRAHMANIAM

(*With sixteen text figures*)

The Tetragnathidae and Argiopidae, with which this paper deals, are two large families of orb-weaving spiders under Arachnomorphae. In these families we come across several interesting and curious genera which present great variation in size, shape, coloration and habits. Some species are so small that without a lens nothing can be made of them. On the other hand there is the well-known Giant Wood Spider (*Nephila maculata*) whose body length measures more than two inches. Most of the members weave plain, circular snares suspended vertically, obliquely, or horizontally among plants and shrubs or between branches of trees. These orb-webs vary considerably in size and make-up in the different genera. Some webs are small with a few radii and spirals; some are large, ornamented in the centre or along the radii with silken lace-work and zig-zag lines (*Argiope*); some have a diametrical line of debris (*Cyclosa*) and some are perfect domes with accessory reinforcements and suspensions (*Cyrtophora*). Some genera, e.g., *Araneus*, *Tetragnatha*, etc., are nocturnal in habits, whereas *Argiope*, *Cyrtophora*, *Nephila*, *Leucauge*, etc. remain in their webs permanently and get away from them only when disturbed. Then there are the forms like *Nephila* where sexual dimorphism (disparity in the size of sexes) is greatly pronounced. There are long-legged forms and short-legged ones. There are smooth-skinned, prettily coloured species and also those with hard integuments drawn into spines, tubercles and prominences. Altogether in view of such wide variations the collection of Tetragnathids and Argiopids is difficult in some cases and easy in others.

Under Tetragnathidae and Argiopidae the more important genera that are commonly found in Bombay and other districts in Western India (including Cochin and Travancore) are:—

TETRAGNATHIDAE	ARGIOPIDAE
1. *Tetragnatha*	1. *Nephila*
	2. *Argiope*
2. *Orsinome*	3. *Cyrtophora*
	4. *Cyclosa*
3. *Eucta*	5. *Araneus*
	6. *Herennia*
4. *Leucauge*	7. *Ordgarius*
	8. *Gasteracantha*

Tetragnathidae

Tetragnathids are moisture-loving spiders and in general structure and habits agree with each other. They are found in large numbers among plants and hedges especially on the vegetative growths fringing pools, tanks and wells and among grass and herbage growing in water-logged localities.

Genus *TETRAGNATHA*

The extraordinarily developed chelicerae, the cylindrical abdomen and the long, slender legs stretched fore and aft in linear fashion —help us to detect this genus. Members are generally nocturnal: the spider leaves its orb-web during the day and hides on the underside of a contiguous leaf or grass-blade. At dusk, however, it comes out of its hiding place, repairs and reinforces the web with fresh threads and occupies the centre.

There are about ten species of *Tetragnatha* recorded from India and the following are those commonly found in Cochin and other Western Indian districts:—

Tetragnatha gracilis Stolicz.
,, *mackenzieii* Gravely
,, *mandibulata* Walck.
,, *cochinensis* Gravely
,, *viridorufa* Gravely

The disposition of the eyes, the nature of the chelicerae and the arrangement of the spines over them vary widely in the different species and are of taxonomical value.

T. gracilis has its lateral eyes prominent and the fangs and mandibles comparatively short. The total length (carapace plus abdomen) does not exceed 12 mm. Members are common in jungles and even during the dry months of April and May they are found in large numbers on the withering twigs of garden plants. One peculiar habit of this species is that it constructs its web on either side of a small twig, the twig itself forming a diametrical reinforcement of the web (fig. 1). The colour of the spider invariably matches that

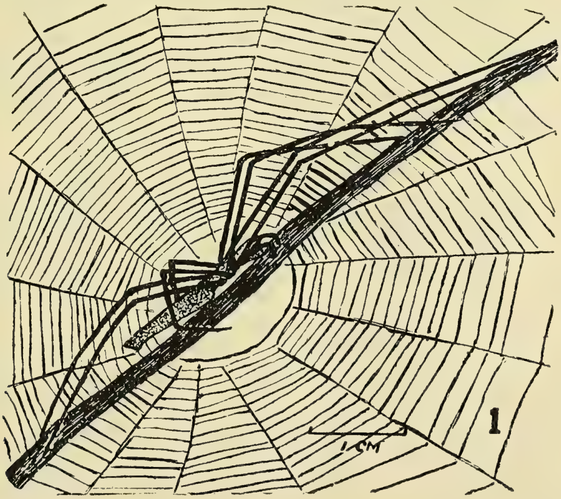

FIG. 1. *Tetragnatha gracilis.*

of the twig and it is difficult to spot the creature when it sits stretched along the twig. But as these spiders are chiefly nocturnal they are found very active towards sunset repairing the old or constructing new webs around the small terminal branches of plants. It appears that this species prefers plants with sparse leaves to those with thick foliage for the construction of the webs.

In *T. mackenziei* the abdomen is greyish and carapace and legs yellowish green.

T. mandibulata is another common species found on plants overhanging pools and tanks. Members generally hide under grass blades or along twigs, stretching their legs in the characteristic tetragnathid fashion. Fully grown specimens measure 13 mm. The fangs are well-developed and provided with two small teeth. The general colour is brownish yellow.

T. cochinensis has a slender but long body measuring about 12 mm.

T. viridorufa is a nocturnal species found among leaves and twigs of jungle trees. The abdomen is long and tubular, more or less squarish in cross-section. The sides of abdomen are coloured green whereas the dorsal side and legs are reddish brown. Males and females do not differ much in size. While mating they grasp each other by their chelicerae. The female tucks her abdomen towards her mate while the latter injects the sperms into her orifice applying his right and left palpal organs alternately during the act of copulation.

Genus *EUCTA*

Eucta javana Thorell is a common species found hiding under plantain leaves. It has a pair of weakly toothed chelicerae, long, slender legs and a very remarkable abdomen produced behind the spinnerets into a long tapering 'tail' (fig. 2). *Ariamnes similans* recorded from Calcutta[1] resembles *E. javana* in general shape and architecture but its tail and abdomen are of a prevailing green colour with silvery and yellowish brown markings. The general colour of *E. javana* is pale brown.

Genus *ORSINOME*

Orsinome marmorea Pocock is an interesting species resembling *E. javana* but with a rounded abdomen. In Cochin, members are commonly found in their horizontal webs attached to rocks by the side of fountains and streams. About the habits of these spiders Dr. Gravely gives the following account:—

'*O. marmorea* spins large and more or less horizontal webs between rocks above rapidly running streams at an altitude of about 1,500 ft. in the Cochin Ghats. Several webs are usually grouped together: often they are stretched above waterfalls. When the spiders are disturbed they fall into the water, which washes them away. When they reach a rock they cling to it, and remain an inch or two below the surface till danger is over. 'Males and females were sometimes found together in the middle of a web with their heads in contact. Presumably they were pairing but I had not time to investigate this fully'.

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[1] Biology of Spiders, T. H. Savory.

Genus *LEUCAUGE* (*ARGYROEPEIRA*)

Genus *Leucauge* like *Tetragnatha* includes several interesting species measuring 6 to 12 mm. in length. All of them possess a row of long hairs on the femur of the 4th pair of legs. The body is beautifully coloured with shining silver over a greenish black background. They are chiefly grass spiders building oblique or horizontal webs and sitting at the centre in an inverted position. They are mostly diurnal, and their mating habits are similar to those of Tetragnatha. Cocoons are long and egg shaped and are attached to leaf blades or leaves on which the spider sits.

The following species are recorded from India by Dr. Gravely:—
Leucauge fastigata (Simon)
,, *tessellata* (Thorell)
,, *celebesiana* (Walck.)
,, *ventralis* (Thorell)
,, *culta* (Cambr.)
,, *decorata* (Blackwall)
,, *bengalensis* Gravely

Of these the first four are fully described in the Fauna of British India. *L. fastigata* has its anterior end of the abdomen conically elevated whereas in *L. celebesiana* it is the posterior end that is conically produced beyond the spinnerets.

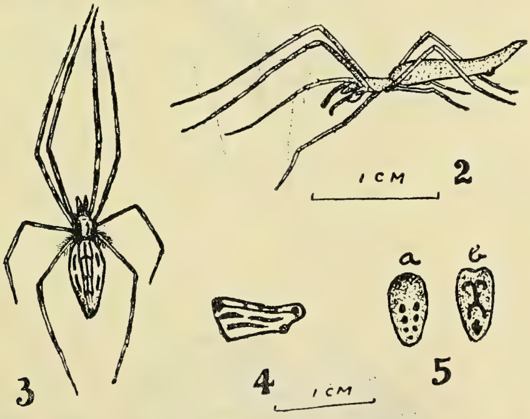


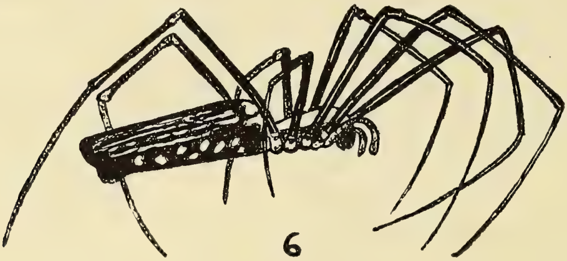
FIG. 2. *Eucta javana.* FIG. 3. *Leucauge decorata.* FIG. 4. Abdomen of *L. decorata.* FIG. 5. (*a*) Abdomen of *L. culta.* FIG. 5. (*b*) Abdomen of *L. bengalensis.*

In Bombay *L. decorata* is found in large numbers in shady places among bushes and herbage. The abdomen possesses a pair of shoulders or tubercles of black colour at the anterior end. The posterior end of the abdomen is also black. Rest of the dorsal side, and the two sides are silvery with a few longitudinal black stripes. In fresh specimens the silver tint is sometimes mixed with an additional pubescent tinge of yellow giving it a golden appearance. On the ventral side the anterior portion is bright green and posteriorly there are silver dots over a black background. Legs and carapace are light green striped black at the joints. The spinnerets, the claws and the hairs on the legs are black. Chelicerae are brownish yellow.

Argiopidae

Genus *NEPHILA*

Genus *Nephila* includes large-sized forms which are all inhabitants of woods and jungles. Under this genus four species are recognised



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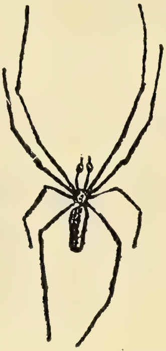

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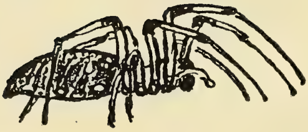

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Fig. 6. *Nephila maculata* (female). Fig. 7. *Nephila maculata* (male). Fig. 8. *Nephila malabarensis* (female).

but one commonly found in western Indian jungles, especially during the rainy months, is *Nephila maculata* or the Giant Wood Spider. The female of this species is verily a giant among spiders, with a body measuring more than 2 inches in length and ¾ inch in breadth. When the legs are stretched fore and aft they cover a length of about 6 to 7 inches. The abdomen is an elongate, truncated cone, black in colour variegated by longitudinal yellow stripes on the dorsal side and yellow or orange patches on the ventral side. The spinnerets are prominent and form a brown rosette. Above this rosette a deep red dot is present. Legs are also black decorated with yellow dots at the joints. Mandibles are brownish black or reddish. Males are insignificantly small and dull coloured. In no other group of spiders is the disparity in size between the sexes so greatly marked. The web of the female is a giant wheel with a hub, radii and spirals, mathematically woven within strong boundary lines attached between trees. The spider generally sits in the centre of the web. To catch a *Nephila* is not very difficult. With a long hook pull the web and down comes the spider. Being a slow runner it can be seized in the folds of a kerchief and dropped into the spirit jar. Regarding the mating and other habits of *N. maculata* readers are advised to refer to the beautiful and elaborate account given by Col. R. W. Hingston in the pages of the Society's *Journal* (Vols. 28 and 29).

N. malabarensis Walck. is common in Malabar but rare in Bombay. This species in general appearance and structure (see fig. 8) stands between *N. maculata* and *Araneus*. The total length of this species is only 25 mm. The abdomen is oval with orange or yellow dots. Spinnerets stout and black and carapace is slightly raised and reddish in colour. Sternum V-shaped and yellow. Legs—femur and tibia yellowish, tarsi blackish covered with fine hairs, joints striped black and brown. The first pair of legs about four times as long as the carapace whereas in the case of *N. maculata* it is about six times as long. Members construct expansive orb-webs obliquely suspended at the angles of tree-branches or on the exterior angles of country-houses. Like *Araneus*, during daytime they remain concealed but at dusk come out to the centre of the web. The webs are permanent structures not renewed every night as in the case of *Araneus*.

Genus *ARGIOPE*

The most important genus under Argiopidae is *Argiope* which gives its name to the whole family. Some eight species are recorded from India and they differ little in their habits. They are found in large numbers soon after the rainy season, sitting in the centre of their splendid orb-webs head downwards (fig. 9). The webs are vertically suspended over fences and vegetation. The spider stretches its legs in the form of a letter X along four rays of the web. At least two of these rays are ornamented with flossy zig-zag bands. The size and shape of the abdomen and the colour design on it vary with different species although as a rule in all cases the abdomen can be described as truncate in front and tuberculated at the sides posteriorly.

In *A. pulchella*, which is the commonest species met with in Bombay, the abdomen is pentangular and banded alternately with brown and yellow. In *A. catenulata* the abdomen is truncate oval and ornamented with round spots instead of bands.

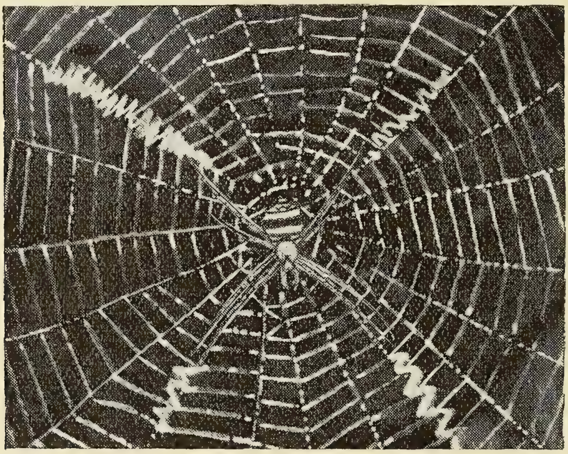

FIG. 9. *Argiope pulchella* and its web.

It appears that the colours of *Argiope* have a definite warning significance as these spiders are seldom found pecked at by birds. Once I noticed a king-crow pecking at the white zig-zag silk arranged along the radii of the web, probably mistaking it for one of the legs of the spider. After this act, I found the bird looking disappointed and morose and cleaning its beak several times against a tree trunk for about five minutes. The sticky threads must have caused this discomfort and the bird did never make a further attempt to catch the spider.[1]

The male *Argiope* is considerably smaller than the female and is of a uniform brown colour. One or two males are often seen in the centre of their small webs built along the upper outskirts of the female web.

The cocoon of an *Argiope* is somewhat pentagonal in shape and slightly yellowish in colour. It is generally attached to the upper side of the web. It takes about three weeks for the eggs to hatch.

Genus *CYRTOPHORA*

The commonest genus of Agriopidae, and that which is most abundant on trees and vegetation, seems to be *Cyrtophora*. This genus is closely allied to *Araneus*, (and has been grouped under *Araneus* by Pocock), but differs from the latter in some structural details and habits. *Araneus*, as a rule, has a round or oval abdomen and legs normal and strong. In *Cyrtophora* the abdomen is longer than wide and provided with four tubercles on the back. The abdomen is beautifully decorated with silver markings on a greenish black background, and slightly produced beyond the spinnerets. The legs are thinner and longer than in the case of *Araneus* and, further, they are coloured green. *Araneus* is nocturnal in habits and its snare is a plain orb-web woven afresh every evening and destroyed early in the morning. *Cyrtophora*, on the other hand, is diurnal and its web is a complicated structure of a permanent nature.

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[1] But it could be that this king-crow was only collecting cobwebs for draping the exterior of its nest!—**EDS.**

Although two or three species of *Cyrtophora* are recorded, *C. ciccatrosa* (fig. 10) is the commonest of them all. Members of this species are of gregarious habits, i.e. several of them build their webs in the same place, each member with its individual web remaining a separate entity. The web of *C. ciccatrosa* can be described as a perfect dome of fine mesh-work suspended horizontally in the midst of a clumsy, irregular tangle of supporting threads. The irregular threads are woven first and over these the radii of the orb are built and then the spirals. From time to time inter-radials and inter-spirals are laid which account for the fine and closely woven appearance of the web. The work of raising the centre of the web is done before the completion of the spirals. Cyrtophoran webs are described by Dr. Gravely thus :

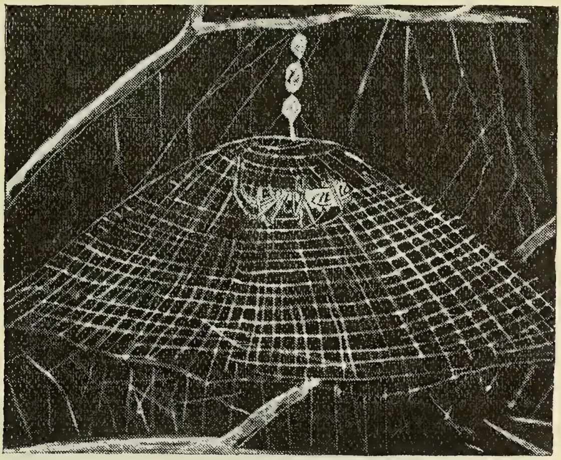

FIG. 10. *Cyrtophora ciccatrosa* and its web.

> 'Members of the genus *Cyrtophora* are remarkable for the extreme complexity of their webs which are probably more elaborate than those of any other spider. Instead of all the radial strands extending outwards from the hub, with interspaces consequently much wider near the periphery than near the centre, additional strands are inserted so as to produce a web of exceedingly fine and uniform mesh. Nor is this all, for these webs are supported in a horizontal position by an extensive network with the help of which the centre of the circle is more or less greatly raised above the periphery, thus forming a sort of tent or dome.'

The spider remains at the centre of the dome in an inverted position. The cocoons are egg-shaped. Eggs are laid in a small silk sheet somewhat greenish in colour, about an inch long and ½ inch wide. The sheet is rolled in the form of an oval cocoon and suspended vertically right above the centre of the dome. Sometimes several cocoons are noticed serially suspended one above the other, but these do not belong to one and the same spider. The lowest one is the property of the spider living in the central web. Each of the other cocoons is owned by the other individuals living in separate webs by the side of the central web. Why the other spiders should deposit their cocoons in the same place where the first spider has placed hers, baffles imagination. This instinct of *Cyrtophora* does not appear to have been satisfactorily explained, and forms a suitable subject for closer observation and study.

Genus *CYCLOSA*

Genus *Cyclosa* includes several small species measuring ½ inch and less in length with colour varying from jet black to fine silver. They have all the characteristics of typical Argiopids but can be distinguished by the raised nature of the caput separated by a groove, the two or more prominences on the abdomen and a line of debris arranged diametrically across their vertically suspended orbs (figs. 11 and 12). Their webs are common in bushes, sometimes

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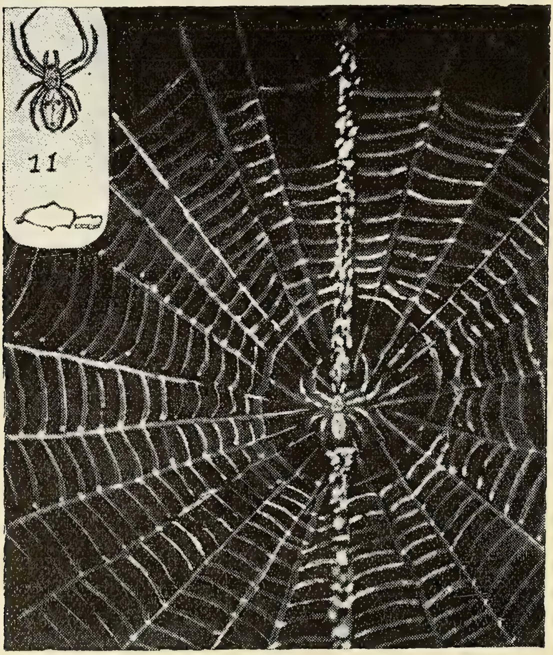

FIG. 11. *Cyclosa confraga* (above). *Cyclosa confraga* profile (below).
FIG. 12. *Cyclosa confraga* and its web.

near the webs of other spiders. In Malabar their webs are a common feature among the foliage of mango trees.

Genus *ARANEUS*

'The immense genus *Araneus* (=*Epeira*) includes many common forms for the most part more or less nocturnal and having the same general form and coloration as the common European garden spider of the same genus.' The colour is often variable, the structure of the vulva affording the safest means of identification. Members are common among plants and herbs. The best time to collect them is at dusk when they come out to spin their webs. With sunrise they dismantle the radials and spirals and keep a few radials, the hub and the boundary lines alone intact. I have several times noticed *Araneus* eating their webs and on having referred this matter to the Zoological Survey of India received some useful comments which I reproduce below:—

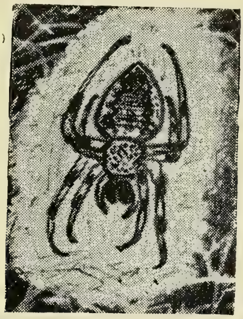

FIG. 13. *Araneus bilunifer* over its cocoon

> 'Comstock in his paper on "Evolution of the webs of spiders" (*Annals of Ent. Soc. of America*, Vol. v, p. 9) observes that in certain members of Argiopidae the entire orb is replaced frequently only the outer foundation lines being a permanent investment. He, however, does not explain why the spiders should break up their webs. Hingston in his "A Naturalist in Himalaya" says that he observed Epeirid spiders eat their own snares; while doing so they swallowed all the minute insects which had got entangled in the webs but were apparently too minute to attract the attention of the spiders at the time of their entanglement.'

During daytime *Araneus* remains concealed in a crevice, curled-up leaf or a special shelter built by it near its orb-web. The cocoon is white and flat, and generally placed near its hiding place. The mother invariably sits over its cocoon presumably to keep it warm and as a protection.

Genus *HERENNIA*

Herennia is another arboreal genus distinguished by the flat pentagonal abdomen with sharply defined lateral edges. *H. ornatissima* is the common species found in Malabar. It is a beautiful spider like Argiope. The abdomen is yellowish, ornamented with black spots. The carapace is blackish with yellowish margin. Legs are long and yellowish. Its orb-web is generally spun close to tree-trunks.

Genus *ORDGARIUS*

Members of this genus have habits similar to those of the above or *Argiope*. The abdomen in this case is very prominent with a large protuberance on either side. The carapace is convex, armed above with a few symmetrically placed tooth-like tubercles. Two species have been recorded: *O. hobsoni* and *O. sexspinosus*. In the former the posterior end of the abdomen is rounded and in the latter it is tubercular and conically produced.

Genus *GASTERACANTHA*

Genus *Gasteracantha* includes medium-sized spiders easily recognised by their peculiarly-shaped abdomen covered with hard integument, and comparatively short legs. Abdomen varies in shape, and the hard integument is drawn into spines of varying sizes in the different species. Some ten species of *Gasteracantha* are recorded, and in habits they all agree with each other. *G. brevispina* (fig. 16), *G. remifera* (fig. 14) and *G. arcuata* (fig. 15) are very common in Malabar. They build their small orb-webs in a vertical plane among low plants and sit in them throughout the day. The spines of *G. arcuata* and *G. remifera* are exceptionally long. Their dull colour and the long spines and integument protect these spiders from their enemies.

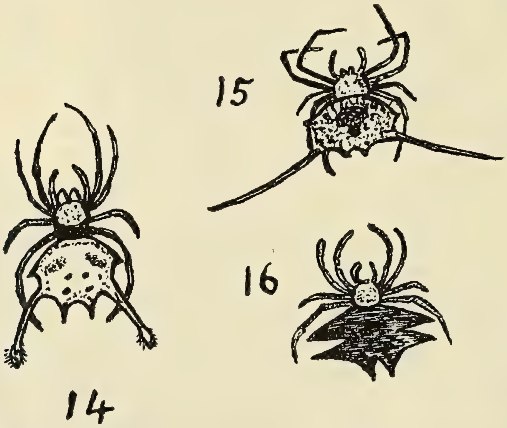

FIG. 14. *Gasteracantha remifera*. FIG. 15 *Gasteracantha arcuata*.
FIG. 16. *Gasteracantha brevispina*.

Based on the above study of the characters and habits of Tetragnathidae and Argiopidae, the following general remarks can be made:—

1. The vast majority of the genera are arboreal and moisture-loving. Naturally they abound in vegetation growing by the side of lakes, rivers, tanks and wells. Their population shows a definite increase soon after the dreary monsoon months.

'When the flowers of the field awake in spring and carpet our woods and downs with their beauty the little folk of spiderland awake with them, true children of the sunlight that they are and the busy round of life begins afresh' (R. A. Ellis).

2. Some genera remain in their webs throughout day and night. Others are nocturnal and come out of their hiding place only at dusk. So mornings and evenings are the best time for collecting these spiders.

3. The diurnal varieties are highly protected either by suitable protective colours matching with the environment, or by bright warning colours, or power of mimicry or by armour and armaments like hard integuments, tubercles and spines. In some cases the webs are also highly protective. When disturbed, dropping to the ground or shamming death are also protective methods noticed among several genera. They are poor runners compared with Hersiliids or Lycosids.

4. Nocturnal species are generally less brightly coloured than the diurnal ones, but have stronger appendages with spines and bristles. When at rest they fold their legs in a peculiar fashion thereby successfully concealing themselves from enemies. Some dismantle their webs during day time.

5. Cocoons are suspended and not carried by the spider. In several genera the eggs hatch in the course of 15 to 30 days after they are laid.

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SOME BIRDS COLLECTED IN LANGTANG KHOLA, RASUA GARHI DISTRICT, CENTRAL NEPAL

BY

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North of Katmandu lies a group of mountains on the Nepal-Tibet border called the Langtang Himal. A tributary of the Trisuli Gandak, the Langtang Khola, cuts a deep valley into this mountain system and runs in a north-easterly direction probably to the southern flank of Gosainthan. An expedition under the leadership of H. W. Tilman visited this area between June and September 1949. Botanical, and geological collections and a photo-survey of the upper part of the Langtang Khola were made (see *Journal of the Royal Geographical Society* 1950, and *Journal of the Royal Horticultural Society* 1950).

Between mid-August and mid-September I made a small collection of birds skins which are now deposited with the British Museum (Nat. Hist.) and which are listed below. All field records included in this list were made from notes taken between mid-August and mid-September and do not refer to observations made at other times during the expedition, except where otherwise stated.

Survey of India topo-sheet 71 H. Gosainkund. Nepal and Tibet, (scale four miles to one inch) includes Langtang Khola from its junction with Trisuli Gandak River up to an altitude of approximately 17,000 ft. A number of accessible lateral valleys and high 'kharka', or summer grazings, were also within the collecting area.

The following are the main place names:

Khangjung—a village at approximately 9,000 ft. a.s.l.

Syarpagaon—a hamlet of a few houses at approximately 9,000 ft.

Langtang—a village of 20-30 houses at approximately 11,000 ft.

Kyangjin Ghyang—a 'kharka' with a number of summer herdsmen's shelters and a small 'gompa'.

Langsisa Kharka—a grazing at 14,000-15,000 ft.

Many of the birds listed were restricted, during the month of observation, to certain types of vegetation, and it would therefore be desirable to record the vegetational zones as they occurred in the Langtang Khola.

Approximate altitude:

8,000 ft. Grassy slopes with scattered *Pinus wallichianum*, *Rhododendron arboreum* and evergreen oaks; also thickets of mixed scrub, probably maintained in this state by cutting and grazing. Winter corn and maize were grown at this altitude.

9,000-11,000 ft. Fir forest, *Abies webbiana*, with bamboo under-shrub; also maples, birch and *Rhododendron barbatum*.

10,000-11,000 ft. Open scrub (5-10 ft. high) with *Berberis*, *Rhododendron*, *Rosa*, *Cotoneaster*, etc.; probably maintained in this condition by cutting.

10,000-11,500 ft. Meadows and cultivation where corn, potatoes and buckwheat were grown. The highest cultivation lies at about 12,000 ft.

11,000-13,500 ft. Birch forest, *Betula utilis* with *Sorbus microphylla* abundant and *Rhododendron campanulatum* undershrub.

11,000-13,500 ft. Mixed shrub (2-5 ft. high) of dwarf Rhododendrons, *Spiraea*, *Lonicera*, *Berberis*, *Potentilla*, etc. A number of 'kharka' lie between these altitudes.

12,000-16,000 ft. Low scrub (about I foot high) mainly composed of *Rhododendron anthopogon* and *Potentilla fruticosa*. The highest 'kharka' lie at the upper range of this type of plant community.

14,000-17,000 ft. Open plant communities of alpine grassland, stream sides, screes, moraines, 'ablation valleys', rock-faces, etc.

It is interesting to compare the list of birds from the Langtang Khola with that compiled by B. E. Smythies during his journey in a neighbouring region in September 1947[1]. It should, however be noted that the conditions under which the two lists were compiled differed considerably. Birds also recorded by Smythies are marked* in the list below. In addition there are a number of cases where the upper altitude limit of some Langtang birds are appreciably higher than the upper limits given in the Fauna of British India. These have also been included. The numbers against each species in the list refer to species numbers in the Fauna of British India, Birds, Vol. 1-7, by Stuart Baker.

I am greatly indebted to Sir Norman Kinnear for his encouragement and help in making this collection: he has kindly supplied me with this list of identifications. I should also like to thank Mr. Sálim Ali for his help.

7. **Corvus macrorhynchus intermedius:** Himalayan Jungle Crow.

One or two pairs about Langtang village and about habitations lower down the valley.

*22. **Urocissa flavirostris flavirostris:** Yellowbilled Blue Magpie.

Occasionally seen in heavy forest, particularly among evergreen oaks and thick scrub. This bird was not seen in the birch forests or above 10,000 ft. It ranged between 8,500 and 10,000 ft. which is higher than Smythies's records.

*48. **Pyrrhocorax pyrrhocorax himalayanus:** Redbilled Chough.

Quite a common bird above the tree zone among rocky ground and low scrub country, from Langtang village upwards. Often about kharkas in pairs or in small parties of up to 5 or 6.

*46. **Nucifraga caryocatactes hemispila:** Himalayan Nutcracker.

Small parties up to 8 in number were occasionally seen hunting for food in the birch and fir trees, up to 13,000 ft. Baker gives up to 12,000 ft.

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[1] 'Some birds of the Gandak-Kosi watershed, including the Pilgrim trail to the sacred lake of Gosainkund.' *JBNHS*, Vol. 47, 1948.

59. **Parus m. monticolus:** Greenbacked Tit.

Quite frequent among bushy country below Langtang village and around Syarpagaon. Baker says up to 10,000 ft.

64. **Parus ater aemodius:** Himalayan Cole-Tit.

Generally formed mixed parties in the birch forests, with the Rufousbellied Crested Tit and Willow Warblers, but it is less common than either of these birds. It was not seen below 11,000 ft.

*65. **Parus rubidiventris:** Rufousbellied Crested Tit.

The commonest tit in the birch forests of Langtang. It occurs between 10,500 and 13,000 ft. A very active bird.

*68. **Parus d. dichrous:** Brown Crested Tit.

Found in bushy country: a quiet and inconspicuous little bird. Collected only at Langtang village and Kyangjin Ghyang.

77. **Aegithaliscus concinnus iredalei:** Redheaded Tit.

Occasional parties of this bright little bird were seen in the shrub country between Syarpagaon and Khangjung. I did not see it in mixed parties with other Tits.

108. **Sitta himalayensis:** Whitetailed Nuthatch.

Quite a common bird in evergreen oak forests between 8,000-9,000 ft., also among *Rhododendron arboreum* scrub. Not observed above this altitude.

137. **Garrulax a. albogularis:** Whitethroated Laughing Thrush.

Two small parties seen near Khangjung in heavy scrub.

140. **Ianthocincla o. ocellata:** Whitespotted Laughing Thrush.

Three parties seen on the borders of forest in heavy bushy country at about 9,000 ft. Not seen above this altitude; they are shy retiring birds.

*161. **Trochalopteron a. affine:** Blackfaced Laughing Thrush.

162. **Trochalopteron v. variegatum:** Variegated Laughing Thrush.

These two Laughing Thrushes were the commonest and most characteristic birds about the scrub round Langtang village. They were found wherever there was adequate cover of mixed scrub or rhododendron, ranging from about 10,000-13,500 ft. Small parties would work through the bushes, flapping clumsily from clump to clump and uttering their harsh many voiced 'chatter' continuously.

*171. **Trochalopteron l. setifer:** Nepalese Streaked Laughing Thrush.

A very common bird sneaking about low scrub round Syarpagaon, and particularly about cultivated areas. Not seen above 11,000 ft. or in heavy forest. It appears to occupy an altitude range below the two preceding species. This altitude is somewhat higher than that usually recorded. A tame but restless bird with a great repertoire of imitative sounds.

177. **Grammatoptila s. striata :** Striated Laughing Thrush.

One specimen collected at Dhunche, Trisuli River, at about 6,000 ft.

214. **Pomatorhinus r. ruficollis :** Nepal Rufousnecked Scimitar Babbler.

A very secretive bird: collected in heavy bush around Khangjung 8,000 ft.: Baker gives up to 6,000 ft. It gave its position away by a single monotonous call note.

220. **Pomatorhinus erythrogenys haringtoni :** Baker's Rustycheeked Scimitar Babbler.

Two specimens collected in heavy bush at Khangjung.

243. **Pellorneum ruficeps mandelli :** Mandelli's Spotted Babbler.

One specimen collected at Nawakot, Trisuli River, at approximately 3,000 ft.

311. **Leioptila c capistrata :** Blackheaded Sibia.

Quite frequently seen in dense rhododendron forest, from 8,500-9,500 ft. Baker gives up to 8,000 ft. A noisy and excitable bird when disturbed.

*333. **Siva s. strigula :** Stripethroated Siva.

Occasionally seen among scrub between 9,000-10,000 ft. Baker says principally between 4,000 and 7,000 ft. Not common as observed by Smythies.

339. **Yuhina g. gularis :** Stripethroated Yuhina.

Two specimens collected, one at Langtang village and the other at Syarpagaon among dense scrub.

342. **Yuhina occipitalis ;** Slatyheaded Yuhina.

Collected among mixed rhododendron scrub above the fir forest zone at about 10,000 ft.

345. **Ixulus f. flavicollis :** Yellowheaded Ixulus.

One bird collected at Syarpagaon 9,000 ft. Baker gives up to 8,000 ft.

386. **Microscelis p. psaroides :** Himalayan Black Bulbul.

Small flocks seen in bushy country around Khangjung.

405. **Molpastes l. leucogenys :** Whitecheeked Bulbul.

Quite common among bushy ground around Khangjung, 8,000 ft.: Baker says up to 7,000 ft.

*448. **Certhia familiaris mandellii :** Tree-Creeper.

Occasionally seen in birch forest between 11,000-13,000 ft. Not seen at lower altitudes.

457. **Tichodroma muraria :** Wall-Creeper.

One bird collected from earth bank above stream near Langtang Village.

*458. **Troglodytes troglodytes nipalensis :** Nepal Wren.

Common among large boulders partially covered with moss and among mountain 'talus' above the tree zone between 13,500 and 16,500 ft. Baker gives up to 13,000 ft. but Smythies records it at 16,000 ft. Often the only small bird to be seen on some stony wastes. Spends most of its time hunting for food under or between boulders.

471. **Pnoepyga a. albiventer :** Scalybreasted Wren.

Occasionally seen among moss-covered boulders in heavy birch forest at about 13,000 ft.

476. **Tesia c. castaneocoronata :** Chestnut-headed Wren.

One specimen collected among bamboo thicket in fir forest at 13,000 ft. Baker says as high up as 11,000 ft.

484. **Larvivora brunnea:** Indian Blue Chat.

One specimen collected at Syarpagaon.

491. **Hodgsonius ph. phoenicuroides :** Hodgson's Shortwing.

Occasionally seen in bushy ground and heavy rhododendron scrub on edge of forest. Collected between 11,000 and 13,000 ft. It was quiet and retiring in its habits.

494. **Saxicola caprata bicolor :** North Indian Stonechat.

One bird collected near Dhaibungkot, Trisuli River at about 7,000 ft.

495. **Saxicola torquata :** Collared Bushchat.

Two specimens collected : one in the Langtang valley at 14,000 ft., and the other at Dhaibungkot at 7,000 ft., in the second week of September.

*502. **Oreicola f. ferrea :** Western Dark Grey Bushchat.

A common bird in bushy country ranging from Khangjung to Langtang village. Commonest about steep terraced hillsides at Syarpagaon.

*525. **Microcichla s. scouleri :** Little Forktail.

Very occasionally seen where the track crosses a streamlet. Only one specimen collected between Syarpagaon and Langtang in the forest area. Not seen above fir forest.

526. **Phoenicurus frontalis**; Bluefronted Redstart.

One specimen collected near Langtang village.

532. **Phoenicurus ochruros rufiventris**: Indian Redstart.

Several specimens collected about Langtang village. Unfortunately this species was not clearly distinguished in the field, but it was probably the bird that was common among the low scrub and boulders up to about 14,500 ft.

*534. **Chaimarrhornis leucocephalus**: Whitecapped Redstart.

Quite a common bird above the tree zone; always to be found near water. Altitude range from about 10,000 to 15,000 ft., and generally to be seen in small parties of from two to five.

*535. **Rhyacornis f. fuliginosa**: Plumbeous Redstart.

Four specimens collected, including one juvenile. Occasionally seen about rocks and boulders at the edge of the Langtang River between 10,000 and 12,000 ft.

*546. **Tarsiger c. chrysaeus**: Golden Bush Robin.

Only occasionally seen above Langtang village and above Langsisa Kharka at about 14,500 ft. Smythies describes it as one of the commonest and most characteristic birds above the tree-line. It is obviously much less frequent in the Langtang valley.

549. **Ianthia cyanura rufilata**: Redflanked Bush Robin.

Frequently seen in, and about the edges of birch forest and rhododendron scrub at about 13,000 ft. Often retiring into thick scrub when disturbed but always giving its position away by a sharp throaty 'prot'.

606. **Monticola cinclorhyncha**: Blueheaded Rock Thrush.

One specimen collected on the bushy hillsides at Syarpagaon.

614. **Myiophoneus caeruleus temminckii**: Himalayan Whistling Thrush.

A characteristic and common bird about the meadows at Langtang village and Langsisa Kharka. It was also quite common in the mixed oak and fir forest in heavily wooded country. Altitude range between 9,000 and 11,000 ft. in the Langtang valley. Smythies did not record this species.

628. **Prunella s. strophiata**: Rufousbreasted Accentor.

This bird is reminiscent of the European Hedge-Sparrow in behaviour and appearance. Small parties quite frequently seen feeding among the weed plants, such as docks and *Polygonum* species, around the summer grazings between 12,000 and 14,000 ft.

632. **Hemichelidon sibirica cacabata**: Sooty Flycatcher.

Two specimens collected at Syarpagaon.

636. **Siphia s. strophiata :** Orangegorgeted Flycatcher.

A locally common bird in clearings in the oak and fir forests at 10,000 ft. It was often to be seen among rhododendron bushes 'bobbing' its tail up and down to expose a white rump while at the same time it uttered a sharp churring sound.

645. **Cyornis t. tricolor :** Slaty Blue Flycatcher.

One bird collected in forest clearing at 10,000 ft.

649. **Cyornis melanoleuca :** Indian Little Pied Flycatcher.

A shy little bird which was occasionally seen among the clumps of thick bush and low scrub around Syarpagaon and Khangjung.

Stoparola melanops styani : Verditer Flycatcher.

Three specimens of this beautiful bird were taken in shrub country at Syarpagaon.

699. **Chelidorhynx hypoxanthum :** Yellowbellied Flycatcher.

Two specimens collected between 12,000 and 13,000 ft.

712. **Lanius n. nigriceps :** Indian Blackheaded Shrike.

One specimen from Khangjung.

714. **Lanius schach nepalensis :** Rufousbacked Shrike.

One of the commonest birds of the Langtang valley above the forest zone from 10,000 to 14,000 ft. Baker says ascends the Himalaya up to 8,000 ft. It inhabits bushy ground, particularly willow thickets among boulders. It is a noisy conspicuous bird.

738. **Pericrocotus b. brevirostris :** Indian Shortbilled Minivet.

Small flocks of this beautiful bird were seen feeding among the tops of evergreen oak trees around Syarpagaon and Khangjung.

**Phylloscopus* spp. Willow-Warblers were perhaps the most numerous of all birds in bushy country at altitudes ranging from the lowest in the collecting area, i.e. 8,000 ft., to the highest scrub at 14,000 ft. They were particularly abundant in birch forests and clearings in this vegetational zone.

The following three species were identified from specimens:

Phylloscopus reguloides. Crowned Willow Warbler.

Forest verge 10,000 ft.

863. **Phylloscopus maculipennis :** Greyfaced Willow-Warbler.

Collected between Langtang and Syarpagaon.

*864. **Phylloscopus p. pulcher :** Nepal Orangebarred Willow-Warbler

Collected at Langtang village and Kyangjin.

889. **Seicercus b. burkii :** Blackbrowed Flycatcher-Warbler.

One specimen collected at 9,000 ft.

891. **Seicercus x. xanthoschistos**: Greyheaded Warbler.

Two specimens collected at Syarpagaon at 9,000 ft. Baker gives 6,000 ft. limit.

923. **Suya c. criniger**: Brown Hill Warbler.

Quite frequent among grassy slopes and cultivated terraces from about 9,000 ft. down to Rasua Garhi (6,000 ft.) in the Trisuli valley. Baker gives up to 7,000 ft.

1024. **Uroloncha striata acuticauda**: Hodgson's Munia.

One specimen collected at Dhaibungkot, Trisuli River.

1044. **Pyrrhula erythrocephala**: Redheaded Bullfinch.

Quite frequently seen among the birch forests, feeding on the seeds of the birch: altitude between 12,000 and 13,000 ft. Occasionally seen in more open bushy country at these altitudes. Baker gives limit of 12,000 ft.

1052. **Propyrrhula subhimachala**: Redheaded Rosefinch.

One bird collected at 13,000 ft. Baker gives limit of 10,000 ft.

*1055. **Carpodacus t. thura**: Whitebrowed Rosefinch.

One bird killed by porter in disused hut at 13,000 ft. on the descent from the Ganga La in the Sun Kosi watershed.

*1059. **Carpodacus p. pulcherrimus**: Beautiful Rosefinch.

Two females collected at about 12,000 ft. in the Langtang valley.

1062. **Carpodacus rhodochrous**: Pinkbrowed Rosefinch.

One specimen collected at 11,000 ft.

1063. **Carpodacus rhodopeplus**: Spottedwinged Rosefinch.

One bird collected at Kyangjin.

1069. **Carpodacus erythrinus roseatus**: Indian Rosefinch.

Two specimens collected, one at Langtang village and the other at Kyangjin.

1076. **Procarduelis nepalensis**: Dark Rosefinch.

This was probably the commonest of the Rosefinches in the Langtang valley. It was collected between 10,000 and 11,000 ft.

1078. **Procarduelis rubescens**: Blanford's Rosefinch.

One specimen collected at about 9,000 ft. on the Dhukpu ridge running southwards from the Ganga La in the Sun Kosi watershed.

*1089. **Hypacanthis s. spinoides**: Himalayan Greenfinch.

A common bird often seen in small parties in open scrub and in cultivated areas from lowest locality in the collecting area to 11,000 ft.

1102. **Passer montanus malaccensis:** Tree-Sparrow.

About houses in the Trisuli valley at 6,000 ft.

1115. **Fringillauda n. nemoricola:** Hodgson's Mountain Finch.

An inconspicuous bird occasionally seen among rather open patches of scrub at Langtang village and Syarpagaon.

1139. **Melophus melanicterus:** Crested Bunting.

One specimen collected near Dhaibungkot (6,000 ft.) in the Trisuli valley.

Motacilla alba subsps: White Wagtail.

One specimen collected at Syarpagaon. Frequent about grazings and streamlets, 11,000-14,000 ft.

1169. **Motacilla alba baicalensis:** Swinhoe's White Wagtail.

One specimen from Syarpagaon.

1174. **Motacilla cinerea caspica:** Eastern Grey Wagtail.

Two specimens collected, one at Langtang at 13,500 ft. and one at 11,500 ft. Baker says up to 12,000 ft.

1194. **Anthus striolata godlewskii:** Blyth's Pipit.

A few birds of this species were seen only during the first week of September only on 'gravelly flats' partially covered with dwarf scrub at 13,500 ft. These birds were probably on migration.

1200. **Anthus pelops:** Hodgson's Pipit.

The commonest bird in the dwarf rhododendron zone from about 10,000 ft. to the highest limit of alpine grassland. It is most abundant on grassy slopes among rough boulder-covered ground. Smythies did not record this species.

1204. **Oreocorys sylvanus:** Upland Pipit.

One specimen collected near Syarpagaon.

1266. **Aethopyga i. ignicauda:** Firetailed Yellowbacked Sunbird.

Only two pairs of this beautiful bird were seen among tall scrub at the edges of oak and fir forest at 10,000 ft. Like the next species these sunbirds were aways seen feeding on the flowers of *Colquhounia*.

1274. **Aethopyga n. nepalensis:** Nepal Yellowbacked Sunbird.

Quite common on the bushy slopes around Khangjung and Syarpagaon, up to 10,000 ft.

1303. **Dicaeum i. ignipectus:** Firebreasted Flowerpecker.

Two specimens collected from the tops of evergreen oaks feeding on Loranthus near Syarpagaon.

1311. **Piprisoma a. agile:** Thickbilled Flowerpecker.

One collected at Dhaibungkot, Trisuli valley.

1337. **Picus s. squamatus:** Scalybellied Green Woodpecker.

Frequently seen among evergreen oak and pines about Khangjung and Syarpagaon. Baker gives up to 7,000 ft.

1370. **Dryobates auriceps:** Brownfronted Pied Woodpecker.

In similar localities to the preceding species but less frequent; also collected at Dhaibungkot. Baker gives up to 7,500 ft.

1436. **Cyanops asiatica:** Bluethroated Barbet.

One specimen collected at Dhaibungkot, Trisuli valley.

1451. **Cuculus c. canorus:** European Cuckoo.

One young bird collected at Langtang village in September. Cuckoos were occasionally heard in the oak forests during June.

*1579. **Upupa e. epops:** European Hoopoe.

Occasionally seen on grassy slopes at 8,000 ft, but one bird also seen at summer grazing at about 14,500 ft.

Cypselus sp: Swift.

Flocks of Swifts suddenly came up the Langtang valley as far as the village in the second week of August, but stayed for a few days only.

1683. **Athene b. brama:** Spotted Owlet.

One collected in dense scrub at Khangjung.

1838. **Treron curvirostra nepalensis:** Thickbilled Green Pigeon.

One collected in wooded country near Khangjung.

*1858. **Columba l. leuconota:** Snow Pigeon.

Quite common in the Langtang valley above the forest zone and up to 16,000 ft. or more. In August most of the small flocks (10 to 30) fed among the screes and boulders at high altitudes, but one flock remained throughout August by river-worn earth banks at Langtang village where they were probably nesting.

*1928. **Lophophorus impejanus:** Impeyan Pheasant or Monal.

Quite common, from 9,000 to 16,000 ft. in open broken ground or among scrub or glades in the forest. Hen birds and young about Langtang village in August, and at this time the cocks were usually in open ground at much higher altitudes up to 16,000 ft.

The following birds were also seen in the Langtang valley above the fir forest zones (11,000 ft.) but specimens were not collected.

477. **Cinclus cinclus:** Whitebreasted Asiatic Dipper.

I saw two of these birds between 11,000 and 12,000 ft. at small lateral streams coming down into the main Langtang torrent.

Streptopelia orientalis : Rufous Turtle Dove.

Pairs of birds often seen feeding on stubble at Langtang village. Field description: bluish rump; pink breast; brown streaked wings; grey on back of head and neck; no apparent collar but bluish at base of the neck.

***Delichon urbica :** House-Martin.

Small parties were commonly seen hawking insects over the meadows and streams up about 14,000 ft.

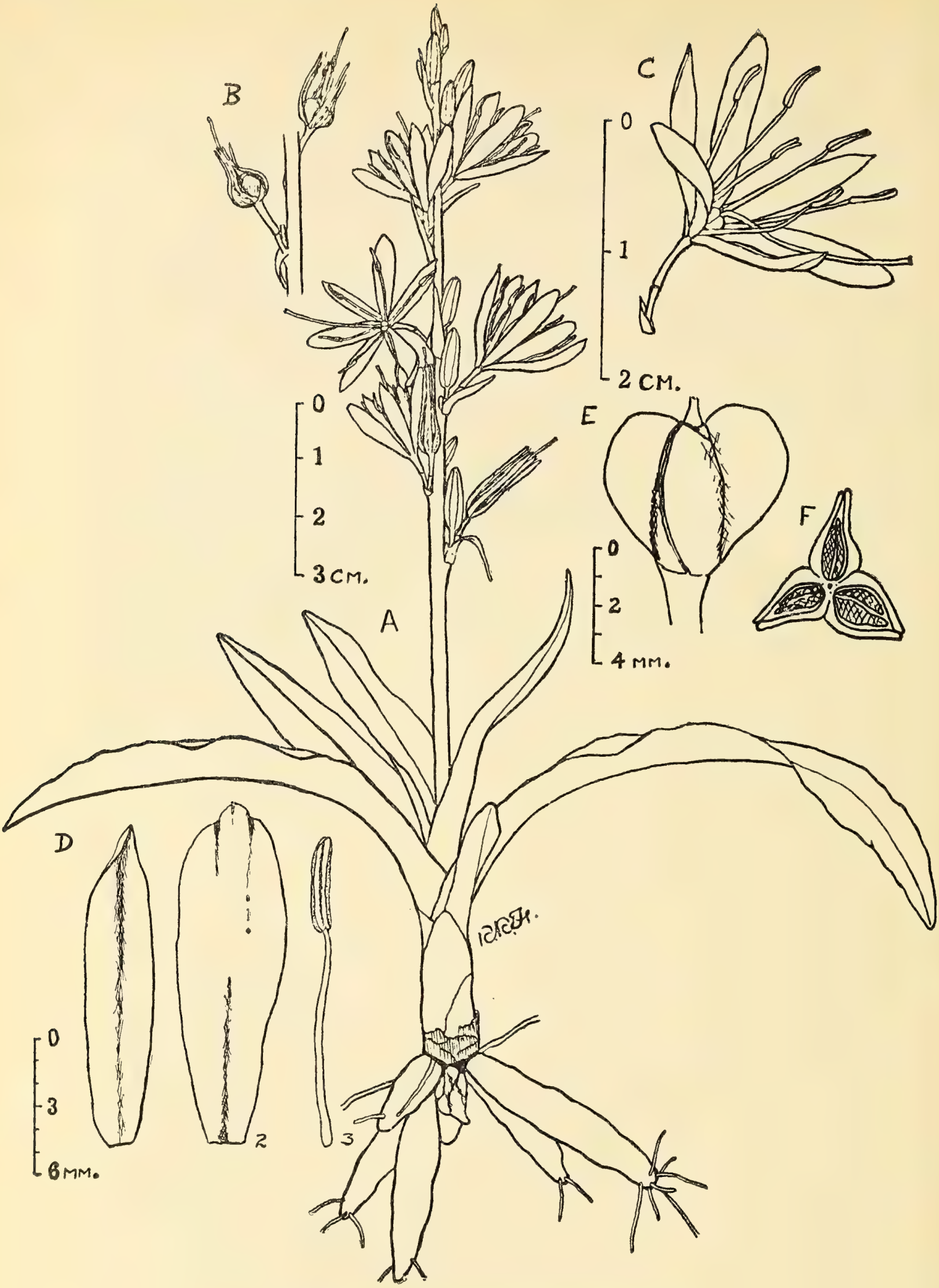
Tetraogallus sp. : Snowcock.

Two coveys of this handsome bird were seen feeding among scree blocks at 16,500 ft.

2132. **Ibidorhyncha struthersii :** The Ibisbill.

A small party of 10-15 occupied the gravelly river flats at Kyangjin Ghyang from June up to our departure in early September.

NOTE: A number of birds of prey were seen, including almost certainly the Golden Eagle. No ducks, geese or waders were seen in the Langtang valley. The characteristic 'croak' of a Raven was heard from some cliffs above 16,000 ft.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Chlorophytum borivilianum sp. nov.

A. Whole plant.
B. A branch in fruit.
C. A single flower, magnified.
D. (i) Sepal; (ii) Petal; (iii) Stamen.
E. Outer view of fruit.
F. Transverse section of the fruit.

A NEW SPECIES OF *CHLOROPHYTUM* FROM SALSETTE ISLAND

BY

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AND

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(*With a plate*)

In the course of our work on the flora of the Krishnagiri National Park, Borivili, Salsette Island, we often came across a monsoon plant, that was obviously a *Chlorophytum*. The general appearance of the inflorescence scape set our plant apart from *C. tuberosum* and *C. attenuatum* at once; the scapes in the present new species are smaller than in the latter species, but the actual flowers are larger than in either species. The structure of the tuberous roots also seemed to be different in that the present plant shows roots that are cylindric, rather uniformly and evenly thickened all along.

The specimens from Borivili were compared with all the sheets in Blatter Herbarium, Bombay, and with photos of all the species from Bombay in Kew Herbarium; our specimens did not seem to agree with any of the species so far described. We then appealed to Dr. N. L. Bor, Asst. Director, Royal Botanic Gardens, Kew, for help. Mr. J. Robert Sealy of Kew Herbarium examined our sheets, and reported on them as follows:

> '*Chlorophytum* from R. R. Fernandes.
>
> I have failed to match this in Kew Herbarium. Among the Indian species the affinities seem to be with *C. tuberosum*, *C. attenuatum*, *C. malabaricum*. All three differ in having tubers some distance from the base of the plant and attached to it by string-like root; in Fernandes's plant the tubers arise direct from the base of the plant. *C. tuberosum* is similar in general appearance and in size of flowers, but the anthers are revolute. *C. attenuatum* is also similar in general appearance, but the flowers are smaller and the anthers much longer than the short filaments. *C. malabaricum* differs in appearance, being short and compact with the dense inflorescence, and the flowers are smaller; the filaments, however, are longer than the anthers in Fernandes's plant.
>
> It is strange that such a distinct species should have been overlooked, when one remembers the amount of work done on the Bombay Flora. I wonder if the plant could be an introduction from elsewhere, but a search thro' the whole of our material of

Chlorophytum has been without results. The tubers of Fernandes's plant seem a distinct feature, at all events I did not see anything quite like them in *Chlorophytum*. Some species of *Anthericum* have similar tubers but the fruit of Fernandes's plant seem to be that of *Chlorophytum*.'

The possibility that the plant might be an introduction from other parts of India, had occurred to us. To settle this point we searched carefully for the spots where the plant did occur in Borivili; we have found it in the forest away from human habitation and at some fairly good distance from any road or path. We are persuaded that the plant is not an introduction. We have often seen introduced plants, but in every case they seemed to be confined to the neighbourhood of gardens, or were found just along the main roads or paths.

Our plant is fairly common and abundant in the plains and lower slopes of the Krishnagiri National Park, Borivili, roughly from the spot where the road meets the river, about 2 miles from the railway station, all along up to the base of Kanheri Caves. One of the sites that seems to be preferred by the plant is the bare spots in the thin forest on the slopes along the main valley of the National Park. Soon after the arrival of the first rains of the monsoon, the leaves appear above ground; in a short while, about a week or ten days, the scapes show up and flowers open very soon; we have noticed that many flowers were open in the early morning, and seemed to close by about noon or early afternoon. We have seen the plant often mixed with *C. tuberosum*, both species growing in rather dense profusion.

Chlorophytum borivilianum Santapau & Fernandes, spec. nov.

Herba perennans per radices tuberosas, quae sunt persistentes. *Radices* tuberosae, fasciculatae, sessiles, cylindricae vel raro ellipsoideae, 1-9 numero, crescentes et numero et magnitudine usque ad maturitatem plantae, extus rubro-brunneae, intus albidae, usque ad 50 × 8 mm. *Folia* radicalia, usque 8 numero, saepe pauciora, 12-18 × 1.5 cm., spiraliter imbricata ad basim, sessilia, lineari-lorata vel ensiformia, acuta, plana vel conduplicata, parum vel nullo modo attenuata ad utrumque apicem, horizontaliter patentia vel recurva, saepe revoluta, evadentia largiora sub fructu, coriacea, levia, marginibus hyalinis atque undulatis, nervis parallelis aeque distantibus atque depressis. *Inflorescentia* 16-30 cm. longa, ut plurimum unica, aliquando duplex, terminalis, saepissime non-ramificans, florifera in superiore dimidia vel tertia parte. *Flores* albi, 2.5 cm. diam., bracteati, pedicellati, fasciculatim alterni, ut plurimum terni in singulis fasciculis, qui inter se proximi sunt ad apicem, sed valde distant ad basim inflorescentiae; bracteae lineares, acutae vel triangulares, vel acuminatae, papyraceae, purpurascentes, usque 2 cm. longae, persistentes; pedicelli albidi, nodosi, geniculati ad nodum, 6-10 mm. longi, inferiore internodali parte trigona, persistente, 2-5 mm. longa, superiore vero decidua, cylindrica, elongata sub fructu. *Perianthium* constans duplici heteromorpha

serie; segmenta omnia divergentia, alba; segmenta exteriora sepaloidea, linearia vel lineari-elliptica, acuta, sulcata ad nervum medium, 3-4-nervia, nervis perspicuis in speciminibus siccis, 1.5-1.8 x 0.3 cm.; segmenta interiora petaloidea, oblanceolata vel anguste obovata, obtusa atque apiculata, plana vel aliquantum convexa, 3-4-nervia, 1.7-2 x 0.4 cm. *Stamina* 6, patentia vel divergentia, inclusa, 1.4 cm. longa; filamenta alba, glabra, latiora ad basim, duplo longiora antheris; antherae curvatae vel arcuatae, lineares, 2-cellulatae, dehiscentes per fissuram longitudinalem. *Stylus* extrussus, albus, aliquantum tumescens ad apicem, curvus, horizontaliter inclinatus, 2 cm. longus. *Ovarium* 3-lobum, angulis obtusis, viride, globosum, 2mm. longum, sessile. *Fructus* capsularis, viridis vel luteus, triqueter vel 3-sulcatus, obcordatus, 5-6 x 6-8 mm.; semina orbicularia vel suborbicularia, discoidea, nigra, singula vel terna in singulis cellulis, usque 3 mm. diam.

Typus lectus a R. R. Fernandes in loco Borivili, in insula Salsette prope Bombay in India, die 14 junii 1954, et positus in Blatter Herbario, Bombay sub No. R. 1810; paratypi (*Fernandes* 1804, 1807 & 1822) repositi etiam in Blatter Herbario; paratypi alii (*Fernandes* 1796 & 1824) in Herbario Kewensi asservantur.

Chlorophytum borivilianum Santapau & Fernandes, spec. nov.

Herbs perennating by means of root-tubers. *Tubers* fascicled, sessile, cylindrical or ellipsoidal, 1-9 in number, increasing in number and size with the age of the plant, reddish brown outside, white inside, up to 50 x 8 mm. *Leaves* all radical, up to 8 in number, often fewer, 12-18 x 1.5 cm., spirally imbricate at the base, sessile, linear lorate or ensiform, acute, flat or conduplicate, slightly or not at all narrowed at the base and apex, spreading horizontally or recurved, often twisted, becoming larger in fruit, coriaceous, smooth, margins hyaline and wavy, veins parallel, equidistant and depressed. *Scapes* usually solitary, occasionally double, 16-30 cm. long, terminal, usually unbranched and bearing flowers in the upper third or half of their length. *Flowers* white, 2.5 cm. in diam., bracteate, pedicellate, usually in alternate clusters each of which consists of three flowers, the cluster being close in the upper, rather distant in the lower part of the scape; bracts linear and acute to triangular and acuminate, papery, purplish, up to 2 cm. long, persistent; pedicels whitish, jointed and kneed at the joint, 6-10 mm. long, disarticulating at the joint, the lower part of the pedicel, i.e. below the joint, trigonous, persistent and 2-5 mm. long, the part above the joint cylindric, elongating in fruit, falling off with the flower or fruit. *Perianth* consisting of two heteromorphous series; segments divergent in flower; outer segments sepaloid, linear to linear-elliptic, acute, medianly grooved, 3-4-nerved, the nerves being clear in dry specimens, 1.5-1.8 x 0.3 cm. in size; inner segments petaloid, oblanceolate to narrowly obovate, obtuse and apiculate, flat to shallowly concave, 3-4-nerved, 1.7-2 x 0.4 cm. *Stamens* 6, spreading or divergent like the perianth segments in flower, nearly as long as the inner perianth segments, 1.4 cm. long; filaments glabrous, broader at the base,

twice as long as the anthers; anthers somewhat curved, linear, 2-celled, dehiscing by longitudinal slits. *Style* exserted, of the same colour as the perianth, slightly swollen at the apex, curved, 2 cm. long; ovary 3-lobed, angles obtuse, green, globose, 2 mm. long, sessile. *Fruit* a loculicidal capsule, green to yellow, triquetrous to 3-sulcate, obcordate, 5-6 × 6.8 mm.; seeds orbicular to coffee-bean-shaped, discoid, black, 1-3 in each cell, up to 3 mm. diam.

The type, *Fernandes* 1810, was collected on the 14 June 1954 at Borivili in the Island of Salsette near Bombay, in India, and is kept in the Blatter Herbarium, Bombay; paratypes *Fernandes* 1804, 1807 and 1822, have also been kept in Blatter Herbarium; paratypes *Fernandes* 1796 and 1824 are in Kew Herbarium, London.

A NEW FORM OF THE BURROWING SNAKE, *UROPELTIS MACROLEPIS* (PETERS) FROM MAHABLESHWAR

BY

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I recently (*JBNHS*, 50: 950; 51: 512) had occasion to draw attention to some specimens of the earthsnake, *Uropeltis macrolepis* (Peters) obtained at Mahableshwar, Satara District, Bombay, which differed from the descriptions in the old and new Faunas, not only in the presence of an unbroken line along the side, but also in the scalation. Messrs. Humayun Abdulali and D. J. Panday have since brought in a dozen more specimens from the same locality which confirm my findings. In view of the consistency of the differences previously mentioned I think it desirable to give subspecific recognition to this population. I therefore propose to call it:

Uropeltis macrolepis mahableshwarensis ssp. nov.

It differs from the typical form in the following characters:

(*a*) An unbroken yellow line along the whole length of the body on both sides. In the typical form the line breaks up into a series of spots about an inch from the anterior end.

(*b*) The sub-caudals range from 9 to 13 as against 7 to 10 in specimens from other localities as per the Fauna.

(*c*) The ventrals range from 120 to 125 as against 128 to 140 in specimens from other localities as per the Fauna.

9 specimens in our collection from Khandala, Lonavla, Igatpuri and Matheran ('Bombay Hills') agree in their scale counts with the Fauna description.

Type: A female bearing register No. 1994 in the collection of the Bombay Natural History Society collected by Mr. Humayun Abdulali at Mahableshwar on 17-10-1951.

Distribution: Restricted to Mahableshwar, *ca*. 4,500 ft., Satara District, Bombay State.

REVIEWS

1. *INDIAN JOURNAL OF FISHERIES.* Vol. I, Nos. 1 & 2. Published by the Editorial Committee, *Indian Journal of Fisheries*, for the Ministry of Food and Agriculture, Government of India. Price Rs. 7-8 net.

Ever since the last World War and the Bengal Famine of 1943, when the need for developing Indian fishery resources was widely recognised, rapid strides have been made in this country in stepping up fisheries research. Consequent on this, the want of a suitable fisheries journal for the publication of the results of investigations has been keenly felt. Fishery workers so far have been encroaching, very often rather too liberally, on the hospitality of general science or zoological and natural history journals. Modern fishery research is largely based on quantitative studies, and fishery workers in this country have been experiencing some difficulty in publishing their findings supported by adequate quantitative data. In these circumstances the publication of a journal devoted to Indian fisheries science fills a long-felt need, and the authorities concerned are to be warmly congratulated for this.

However, the name of the publication, *Indian Journal of Fisheries*, does not appear to be quite appropriate since in effect it is a journal of the Central Fisheries Research Stations. All the papers published in it, except for the solitary instance, namely 'A note on some deep sea fishing experiments off the South Western Coast of India' by K. Gopinath, Director of Fisheries, Travancore-Cochin State—which also happens to be a report of work done under the auspices of Central Government—deal with the work in the two Fisheries Research Stations at Calcutta and Mandapam. The fact that the Annual Reports of these two Stations are also included in the journal and that the Editorial Board consists of only ex-officio members, shows that it is actually the journal of the Central Fisheries Research Stations.

Long before the establishment of these two Research Stations, a considerable amount of fisheries research, mostly in its biological aspects, has been conducted in the Universities and State Government Fishery Laboratories, besides in other research institutions such as the Zoological Survey of India. The *Journal of the Bombay Natural History Society, Journal of the Asiatic Society, Journal of the Zoological Society of India, Proceedings of the National Institute of Sciences of India, Records of the Indian Museum,* and several other periodicals, have been publishing and will continue to publish on *merit* papers from official and non-official scientists as heretofore. It may, therefore, be regretted that the *Indian Journal of Fisheries* is not as broad-based as its name would imply. It is earnestly hoped that if it is intended to continue this name, the scope of the journal with regard to its contributors will also be widened.

The journal is intended 'to provide a medium for publication of original contributions and critical reviews in the field of fisheries research' and to 'cover subjects relating to fishery biology, fishery technology and other scientific topics of direct and indirect bearing on the development of fisheries science in general and of Indian fisheries in particular'. But out of the 13 papers published in the first two numbers of the journal, 10 mainly relate to fishery biological problems, two deal with physico-chemical factors governing biological production, and one gives an account of certain fishing experiments. It will be readily admitted that the list of contents thus falls short of the objectives set forth. It is, however, hoped that every effort will be made to include in subsequent numbers a proportionate number of papers relating to various aspects of fisheries science. It may here be pointed out that 'development of fisheries' includes all aspects of biological, technological and sociological studies, including the improvement of fishing nets and crafts and the betterment of the social and economic condition of the fishermen.

The first issue of the journal, which consists of the 2 numbers of Volume I, contains 13 papers covering 416 pages, some of which are of a fairly high standard. The papers have been well edited, but it would appear that the titles of many could be shortened with advantage. Similarly, the printing of the same illustration on page 3 and on page 346 could have certainly been avoided.

On the whole, the get-up of the journal is good and the number of printing mistakes are few. One would have liked to see a more pleasing emblem to adorn the cover page of the journal; and perhaps something from old cultural works might have been more appropriate.

2. COMMON INDIAN HERBS. By N. A. Watts. Published by The First Calcutta Local Association, Bharat Scouts and Guides. Pp. 22, 72 illustrations.

3. FLORA OF AGRA DISTRICT. A descriptive key to the Flora of Agra District. By N. A. Watts. Published by the author. Pp. 34.

These are two popular booklets that aim at spreading the knowledge of plants among the younger generation and creating a lively interest in the study of plants. The author has rendered Indian botany a good service.

The first booklet, Common Indian Herbs, gives first a set of notes for beginners on how to collect the plant and take notes on its habits, etc. 72 plants are listed in the key on p. 6; the key is based on obvious external characters that can be observed even without a hand lens. Each plant is then described in a simple manner; English, Bengali, Hindi and Tamil names are given where such names are available. In the last part of the booklet each of the 72 plants is illustrated by a small but clear line diagram; the diagrams are labelled with the English and Latin names of the plant.

The second booklet consists entirely of a set of keys; the first to the families, the second to the species within each of the families. There follows a short bibliography. This booklet is based on scientific terminology and may be found somewhat difficult by those not familiar with technical terms. A number of plants is mentioned in this book that have not been recorded by previous workers.

The first booklet, Common Indian Herbs, is of great interest, and I have nothing but praise for it. The second, Flora of Agra District, requires some important corrections since the work is offered as a more or less technical work. To mention but a few points: on p. 7 the author lists *Nymphaea lotus* Linn., which is definitely not an Indian plant; the plant listed under *Nasturtium indicum* is now placed under the genus *Rorippa* and goes as *Rorippa indica*; *Gynandropsis pentaphylla* should be *G. gynandra; Ionidium* goes to the genus *Hybanthus*, etc. In spite of these slight blemishes, I recommend the book to students of the Flora of Agra.

November 6, 1954. H. SANTAPAU, S.J.

4. A COLOURED ATLAS OF SOME VERTEBRATES FROM CEYLON, VOL. II. Tetrapod Reptilia. By P. E. P. Deraniyagala. Pp. 101 ($12\frac{1}{2}'' \times 9\frac{1}{2}''$). 11 half-tone and 35 coloured plates, and 44 text-figures. The Ceylon Government Press, 1953. Price not indicated.

This volume is the second of the series and deals with 9 Testudinates (tortoises and turtles), 23 Geckonids, 12 Agamids, 1 Chamaeleon, 25 Skinks, 1 Lacertid and 2 Varanids. The descriptions and illustrations are accurate, and the rare combination of a keen naturalist and a gifted artist in the author, is well in evidence.

Definitions of Orders, Suborders, Families, Subfamilies and Genera have been revised in the light of new knowledge. Additional information based on the author's personal observations regarding anatomy, reproduction and ecology of several species, is furnished. Simple keys for identification of species, intelligible even to a beginner, are given.

Synonymy indicating original nomenclature, follows every Order, Family, Genus and Species. The author has taken care to select the most appropriate of the existing synonyms, as for instance, to denote the Order of tortoises and turtles, 'Testudinata' Oppel 1811 is preferred to either 'Testudines' Batsch 1788 or 'Chelonia' Macarthey 1802 since 'Testudines' happens to be the plural of 'Testudo' and 'Chelonia' is the name of one particular genus.

Common English names as well as those in local languages are listed under each species, and wherever these were wanting new ones have been coined and marked as such. These should add greatly to the student's convenience.

The bibliography and indexes to scientific and common English names, as also to those in local languages, appended at the end and a well-documented chapter on the Zoogeography of Ceylon increase the reference value of the Atlas.

A bigger map of Ceylon than supplied would have been more convenient for users. Some lizards and snakes—for example, *Cnemaspis kandianus tropidogaster* Boulenger and *Riopa punctata* (Gmelin) respectively—are depicted in brighter colours than they appear to possess in nature, but the reviewer does not wish to be dogmatic on this point for want of closer acquaintance with the Ceylon fauna.

The get-up of the Atlas is attractive and the print clear. The present literature on Herpetology is very meagre, especially works of reference, and Dr. Deraniyagala's Atlas forms a welcome addition. No library of natural history of the Indian Region should be without it.

V.K.C.

5. BIRD LIFE. By Niko Tinbergen. Pp. 62, ($9\frac{1}{4}'' \times 6\frac{3}{4}''$). Coloured frontispiece, numerous photographs and pen-and-ink illustrations. London, 1954 (Oxford University Press). Price 8*s*. 6*d*. net.

This little book is the fourth volume in the excellent Oxford Visual Series which deals with subjects connected with physical or natural science.

The author is one of our foremost exponents in the study of animal behaviour. Those acquainted with his other remarkable books 'The Study of Instinct' and 'Social Behaviour of Animals' will appreciate their good fortune in having from him this lucid exposition of the ways in which birds live, how they may be watched intelligently and how even a beginner may, with persistence and enthusiasm, contribute to scientific ornithology.

The book is divided into 28 short chapters each of two facing pages. Almost every aspect of the living bird is covered in simple lucid language, supported by appropriate illustrations. Collectively, these short chapters form an admirable introduction to the ways and lives of birds, and offer a number of suggestions to those who would add purposiveness to the pleasure they derive from watching birds. The observations recorded on p. 35 on young hobbies are an example of the author's meticulousness; and 'Watching a Family of Great Tits' (p. 36) is suggestive of suitable techniques for profitable and amusing bird watching. We are told what is known about particular aspects of the lives of birds and what remains to be learnt. Every chapter bears the impress of the author's intimate familiarity with the problems. The simplicity of style and avoidance of the rather formidable jargon that has now grown up around animal behaviour studies is refreshing. Instinctive Actions of Birds, Bird Language, Learning by Experience &c. round off this admirable introduction to the fascinating subject of Bird Behaviour, and the final chapter—Some Practical Hints—convinces the reader of what an interesting hobby watching the ways of birds can be. In every respect here is a book to be recommended to the 'practising' ornithologist no less than to the beginner. Its usefulness in India is particularly heightened by the suggestions it contains for studying the living bird, and of the simple techniques that may be employed.

S.A.

6. THE WATERFOWL OF THE WORLD. By Jean Delacour. Vol. I, Pp. 284 ($9\frac{3}{4}'' \times 7\frac{1}{4}''$) Sixteen plates in colour by Peter Scott; 33 text maps. London, 1954 (Country Life Ltd.). £5-5-0 net.

The waterfowl of the world has been decreasing at an alarming rate, and concern in its behalf is felt in almost all countries of the civilized world to-day. The causes of this decline are many and complex. Basic among them is, of course, the increasing pressure of human population throughout the world and the consequent opening up, through reclamation of marshlands and colonization, of remote areas where the birds could hitherto live and breed comparatively unmolested. Added to this is the phenomenal progress achieved during the last three decades in air transport which has brought even the remotest refuges within easy and convenient reach of the hunter. In the context of this deteriorated world position and the wide sporting and scientific interest enjoyed by this group of birds, a book like the present is particularly timely. The need for such a comprehensive, authoritative and up-to-date work on the waterfowl has long been felt, and the obvious person to produce it was Jean Delacour. His long experience of wildfowl in many parts of the world, his unrivalled knowledge of their habits and behaviour derived from a lifetime of studying and breeding in captivity almost all the known species, and his competence as a systematic ornithologist combine to fit him eminently for the task. Supplementing his own are the knowledge and experience of another celebrated wildfowl enthusiast and expert, Peter Scott, and the vicarious contributions of numerous other sportsmen, students and breeders of ducks and geese.

Peter Scott's especial contribution to the book is the 16 excellent colour plates of the birds described. Those showing cygnets, goslings and ducklings in down plumages are of very particular usefulness and value, since many of them have perhaps never been illustrated before.

The three volumes planned will cover the entire family Anatidae—Swans, Geese and Ducks. The present volume deals with the Magpie Goose, Whistling Ducks, Swans and Geese, Sheldgeese and Shelducks. The classification follows the natural grouping proposed earlier in the author's epoch-making paper ('The Family Anatidae', 1945) published conjointly with Dr. Ernst Mayr, which emphasizes the importance of behaviour, in addition to morphology, in the assessment of phylogenetic relationships—a view to which more and more taxonomists are happily inclining.

The information is ranged under the following heads: Characteristics, Distribution, General Habits, Captivity—first of each tribe and genus, and then broken up into its component species and races. Workmanlike keys are provided, and the 33 distribution maps in the text showing breeding and non-breeding ranges are of great usefulness.

This first volume of 'The Waterfowl of the World' fully justifies itself, its author, its illustrator, its publisher and its printer, and the two volumes to come will be eagerly awaited.

S.A.

7. THE TEMPLE TIGER AND MORE MAN-EATERS OF KUMAON. By Jim Corbett. Pp. 197 (7¾″ × 5″), 10 plates (photos). Oxford University Press, Rs. 6-8.

Most of Jim Corbett's readers are by now so conditioned that they can face the man-eaters in his pages with the same casual courage with which he faced them in real life; but there are some passages in his new book which shook even this brave reviewer. For instance, when Corbett, himself suffering from a severe abscess in the ear, is chasing a man-eater in the moonlight. Overcome by vertigo, he has to stop and get into a tree where his abscess bursts. Next day, his ear better, he is running after the tiger again.

Readers of this journal will know Col. Corbett's qualities as a shikari, naturalist, and writer too well for us to labour in his praise. The facet of his writing which we would now stress is that which the *New Statesman and Nation* pointed out some time since: that his books make the ideal substitute for the evil rubbish—miscalled comics—on which today's children feed their minds. Presumably the children are looking for excitement, danger, heroism. They will find it all in Col. Corbett's book. Some of his exploits would put to shame the derring-do of the fictional supermen. Surely our adolescents are not incapable of appreciating the subtle heroism of Corbett's act when he took aim with his ears and fired at the slight noise of the tiger at his kill, since the animal itself was hidden? or his feat of shooting a heavy rifle with the butt unsupported because, with the tiger directly under the branch on which he sat, there was no other way of doing it? Add to this the fact that Corbett writes superbly well—a fact to which the name of his publishers bears testimony—and even the most fastidious parent could not ask for better books on which to bring up growing children.

This is not to detract, in any way, from the book's value for grownups, but merely to emphasize that this is one of those rare books which both older and younger people can enjoy equally. Perhaps some children might even imbibe from it, what they seem to be in danger of not learning at all in today's world, that real courage is not brutal; it is compassionate and modest. A random instance which illustrates the tone of Corbett's descriptions is the killing of the Panar man-eating leopard. This leopard had been wounded, and though it was a dark night Corbett followed it at the insistence of his men, and against his own better judgment.

'Having acceded to their request, I made the men promise that they . . . would hold their torches high, and not run away and leave me in the dark if the leopard charged . . . .' However, when the time came, 'There is something very terrifying in the angry grunt of a charging leopard, so I was not surprised when my companions, all of whom were unarmed, turned as one man and bolted . . . . On hearing my shot the men stopped running, and then I heard one of them say, "Oh, no, he wont be angry with us, for he knows that this devil has turned our courage to water." Yes, I knew, from my recent experience on the tree, that fear of a man-eater robs a man of courage. As for running away, had I been one of the torch bearers I would have run with the best . . . . Presently, while I was making believe to examine the leopard, to ease their embarrassment the men returned in twos and threes.' This delicate respect and consideration for the hill-people is implicit in every word he writes, while very often he goes to great lengths in order to do them a service; as for example when he accompanied a chance-met little girl and her bullock many miles out of his way because he thought there might be a man-eater in the vicinity. Or when he sat up the whole night guarding a house where a leopard had mauled a woman.

The reason for Col. Corbett's spectacular success as a hunter of man-eaters is that he has studied—so meticulously as to merit an honorary PH.D. for research in jungle-life—the behaviour, habits, reflexes, almost the psychology, of all that lives in the jungle, with special reference to tiger. The more tangible results of his observations he has discussed in 'Jungle Lore' which was reviewed in the last issue of this journal. It is this intimate knowledge of the mind of the animal which enables him to forestall all its movements and actions. This same habit of minute and accurate observation enables him to trail a tiger with the same apparent ease with which we would follow the Grand Trunk Road. The bark of trees, leaves, grass, every rustle and sound are like signposts telling him about his quarry's every move.

Sandwiched between the tiger stories are a great many anecdotes of natural life. All such anecdotes from a man who has trained himself to be such an exact observer are bound to be interesting to the naturalist. In one instance Corbett mentions a pair of ospreys that had been nesting for many years in a certain tree. Now, this is particularly interesting since it is perhaps the only authentic record of the osprey nesting in this part of India.

On the back cover of the present volume, printed among the excerpts from former reviews, is quoted a critic who seeks to praise the 'Man-eaters of Kumaon' by comparing it with 'The Man-eaters of Tsavo'. With all due deference all round, we do not think that 'The Man-eaters of Tsavo' can be classed with Corbett's books. These are in a class by themselves.

L.F.

8. BIRDS OF ARABIA. By Col. R. Meinertzhagen, D.S.O. Pp. xiii + 624. Folding map; 19 plates in colour, 9 in monochrome; numerous text-figures and text maps. (10½" × 7½") Edinburgh and London (Oliver & Boyd). £4-4*s*. net.

Arabia is popularly pictured as a land of endless sand-dunes—a trackless, waterless waste where the withering simoom howls over the desiccating bones of travellers and their camels who have perished of thirst and exposure. Thus, to those whose knowledge of the country rests solely on what they learnt from So & So's Advanced English Readers for Indian Schools it may come as a revelation that in actual fact only 1/5 of Arabia is sand, the rest being fertile land only impoverished by lack of moisture and perennial streams and surface water; that the escarpment of the central plateau of Arabia rises steeply from the Red Sea maritime plain to heights between 6 and 11,000 ft. above sea level (almost to an Alpine zone); that in the highlands of Yemen—where some of the finest coffee grows—the rainfall, which is less than 1 in. per year in the drier parts, is as high as 30 in. per annum, equal to many parts of the Deccan and Malwa plateaux in India, where we have some of our finest deciduous forests.

No less astonishing seems the profile of the wild life in such a country of popular conception, gazelles, wild goats, wolves and leopards being still tolerably plentiful in parts. However, it seems that the doubtful 'civilization and progress' that the Oil Age has brought to Arabia—aided and abetted by the modern rifle and the Jeep—are, as elsewhere, doing their pernicious bit to decimate wild life in the shortest possible time. The bird life of Arabia is also far richer than is usually imagined, and contains many forms of great scientific interest. Apart from the few desultory reports on Arabian birds that have appeared in various scientific journals within recent years, very little is known, especially in regard to ecology, migration and other aspects that concern the living bird in its natural habitat. The difficulties of travel in Arabia and the general disfavour with which visits of foreigners, especially Europeans, has been looked upon, have been the chief causes of this backwardness.

Ornithologists are fortunate in having as author of the Birds of Arabia one whose intimacy and wide knowledge of deserts, and life conditions in deserts, throughout the world is unquestioned. His special familiarity with the birds of the Palaearctic Region in general, and particularly with those of the Middle East and Egypt, eminently qualify him for the task.

The book is indeed a mine of information. The systematic list covers all the birds known from Arabia and adjoining lands of similar physiographical character—Description, Distribution, Habits, Allied Forms. In the words of the author, it is 'not strictly an account of Arabian birds but embraces all the desert birds of extreme South East Asia'. The chapter headings give some idea of the comprehensive nature of the contents. (1) Geology, Geography and Climate; (2) Desert Coloration (which deals with such topics as Effect of Soil on Plumage and Pelage, Effect of Diet on Plumage, Camouflage etc.); (3) Distribution and Migration; (4) Systematics and Nomenclature.

After the Systematic List of birds, which follows, come two useful Appendices: History of Arabian Ornithology and Works Consulted. An Addenda contains additional notes on various topics, obviously written after the main MS had gone to press. A complete index of species ends the book.

The first four general chapters are admirable. They are written with zest and conviction and often with that unconventional cynical humour which is so characteristic of the author's writings. They will repay careful reading, and in parts, re-reading. They contain a wealth of first hand data and their interpretation by an experienced and observant biologist refreshingly unfettered by orthodox views and dogmas and with the courage to differ from, and criticize, hide-bound notions, and with a rational, common-sense approach to biological problems.

What adds particularly to the scientific value of the book and to its interest for the general reader, is the large number of original and penetrating observations—admittedly not always of immediate relevancy—on a vast variety of topics which the author is able to record from a lifetime of bird study in the field in all parts of the world. A core of stubborn fact, with a dash of speculation and a dash of theorizing, is Meinertzhagen's forte. It is this that makes his views on so many controversial topics of biology so unstereotyped and refeshing.

The chapter on Systematics and Nomenclature is an example. In a way it is the author's confession of faith, and contains a great deal with which this reviewer and many of his fellow-travellers in ornithology will heartily agree. The weightage he assigns to habitats and ecology in systematic classification, and his pungent remarks on the regrettable tendency of some ornithologists to lose sight of the basic scientific function of the trinomial system of nomenclature, so that by cluttering up taxonomy it hinders rather than helps progress in systematics will be endorsed by all workers who have suffered, and who continue to suffer, from the importunities of a few habitual offenders.

It is difficult to do proper justice to a book like this within the limitations of a short review. What will impress the reader most is the vast amount of first hand original information it presents, which bespeaks the author's keenly observant and critical mind.

The colour plates by George Lodge, Archibald Thorburn and David Reid-Henry are superb and pleasing examples of ornithological portraiture, and the distribution maps in the text should prove of great usefulness.

The one debit entry on this highly gratifying balance sheet—a truly heavy one—is the weight of the tome, over 4½ lb.! With the best will in the world it needs a lot of youthful vigour to handle a weight of this order as often and as freely as one would wish!

S.A.

9. THE BIRDS OF THE BRITISH ISLES. By David A. Bannerman and George E. Lodge. Vol. III, Pp. viii+399 (10½″×7¼″). Coloured plates. Edinburgh & London, 1954 (Oliver & Boyd). 45*s*. net.

This volume completes the Passeres continued from Vols. I and II (reviewed in the *Journal*, Vol. 52, p. 198). It deals with the Warblers, Robins, Thrushes, Accentors or 'Hedge Sparrows', Wren, Dipper and Swallows. These three volumes, we are told, comprise the first portion of a set that will cover the entire avifauna of the British Isles. Further parts are under preparation.

This sumptuous set of books is a truly phenomenal undertaking in the context of present-day printing costs, but then George Lodge himself was a phenomenal bird artist. It would have been a tragedy if his beautiful portraits of British birds had had to be withheld from an appreciative public for want of funds, which but for his generous bequest of the originals and the cost of their reproduction, would almost certainly have to be the case.

Lodge could scarcely have found an abler collaborator than David Bannerman who is responsible for the text. The entire production is on a gracious scale—such as one is accustomed to associate with books of the spacious days of the last century, before—as one ornithologist has pithily put it—'the placid stream of ornithological publications turned into a raging torrent'. Now that we already possess a sufficiency of standard, strictly utilitarian reference manuals on British birds, it feels good to be able to pick up one that is not desperately earnest and tabulated, and that affords pleasant and enjoyable reading at the same time as it informs and instructs.

S.A.

10. A WANDERER IN THE WIND: The Odyssey of an Animal Collector. By Cecil S. Webb. Pp. 302 (9″×6″). 51 illustrations. London, 1953 (Hutchinson) *21s.* net.

Here we have a most readable book. The author has spent a large portion of his life in the wilder parts of the world collecting birds and animals for zoos. But his attitude to nature is not merely that of a 'collector' which is usually very mechanical and commercial. It is evident that he has taken a keen and intelligent interest in his work, and has looked at his captures as living creatures to be studied in and out of captivity. Many interesting facts are recorded of wild animals and birds, often together with explanatory observations which are of considerable interest. The African Civet Cat is said to devour as roughage quantities of unmasticated coarse dried grass which pass through the intestinal tract without being affected by the digestive juices. This grass is remarkably free of excrement, and together with the fact that quantities of civet-cat excrement are found in certain spots, it has led to the belief that the animal withholds its excrement for long periods by means of the grass wad which it inserts into the rectum!

Many of his notes and observations on African species are of interest in India also; for example he draws attention to young Jacanas diving like grebes which the adults do not apppear to do. The South American tapirs in captivity, he says, should be treated like hippopotamus for they will spend much of their time swimming and often diving out of sight for considerable periods.

In the Cameroons he looked for, and obtained, specimens of the world's largest frog—*Rana goliath*—which is about a foot long. In Madagascar he saw many orchids including *Avgraecum sesquipedah* with ivory white blooms averaging six inches across and a spur about a foot long: He has interesting notes on lemurs of which he handled several species. He obtained the Tailless Tenrec (an insectivorous mammal of Madagascar) in which thirty-two well-developed embryos have been taken in one specimen.

In 1935, he saw a Pinkheaded Duck in the Calcutta Zoo—perhaps one of the last seen in captivity, or even alive at the time.

But I must stop. Picking out interesting bits is not reviewing, and I can only repeat that though there are 300 pages, wherein the author travels in Africa, India, Indo-China, Australia and South America, there always is something or other of interest to anybody with the slightest leaning towards natural history.

H.A.

ADDITIONS TO THE SOCIETY'S LIBRARY

The following periodicals were presented by Mr. J. I. Alfrey to the Society's Library :—

1. The Proceedings of the Royal Entomological Society of London—Series A : 16 volumes; Series B : 16 volumes and Series C : 16 volumes.
2. The Transactions of the Royal Entomological Society of London—11 volumes.
3. List of Fellows of the Royal Entomological Society of London—January 1, 1952.
4. Journal of the Bombay Natural History Society—13 volumes.
5. Journal of the Bengal Natural History Society, Vol. XXVI, No. 3.
6. 11 reprints of various articles.
7. Journal of Royal Horticultural Society—6 volumes.

MISCELLANEOUS NOTES

1. STRANGE BEHAVIOUR OF MONKEYS IN THE PRESENCE OF A PANTHER

This incident dates from the time when I was employed on the personal staff of the Maharaja of Dholpur. Just after the Holi in March 1944 I was asked to investigate the rather mysterious disappearances of some of the langur monkeys in the wild life sanctuary at Kesarbaug, where they usually enjoyed a peaceful and sheltered existence.

On that particular day I was on duty at the Palace which stands in the midst of fairly wild and dense mixed jungle, some six miles from the town of Dholpur. One early morning, while having my breakfast on the verandah overlooking the western slopes of the Kesarbaug Hill, I saw a vulture landing on a grassy patch about 600 yds. away. Suspecting a kill of some animal I went there to investigate, and to my surprise found the mortal remains of one of the missing pet monkeys. There was not much left except the head severed from the trunk, the tail and arms, with palms untouched, and the intestines. The grass on that spot growing rather tall, about 3 ft., was pressed down by some animal over an area of approx. 4 ft. radius. Following the traces of a drag towards a stream I noticed on the soft ground pug marks of a full-grown panther. On the other side of the stream the rest of the langur's body was thrust inside a thick thorny bush. There was of course no sign of the panther, so after duly noting the place I returned to my quarters determined to destroy the beast when the opportunity came. Four days later, sitting on the same verandah at 10 p.m., I was admiring the beauty of moonlight shining on the jungle when I was suddenly alerted by the warning barks of a male langur. Suspecting the presence of the panther I seized my 12-bore shot-gun with L.G.s and a strong battery spot-light and cautiously climbed down towards the trees whence the warning was sounded, some 60 yds. at the foot of the hill. There, on a group of three trees just behind the servants' quarters, the monkeys were in the habit of gathering for the night. I took up position below a pipal tree under an awning projecting from the building. The moon lighted up the ground very clearly. There were many monkeys on the tree in an extremely excited condition, jumping from one branch to another, shrieking and shaking the foliage and emptying themselves so as to produce a regular shower of droppings. The ground under the trees was flat and devoid of any vegetation. In spite of straining my eyes I failed to discover the cause of their fright. The line of the jungle bushes was some distance away and it is possible that the panther had taken his ambush there unseen by me but detected by the monkeys.

The excitement in the tree did not seem to subside and the monkeys were becoming more frantic every minute to the extent of running around the crown of the tree in mad circles. Suddenly one of the crowd of monkeys came crashing down through the branches under the tree, either through loss of balance or some other cause, and remained there some 10 ft. away from me, perfectly immobile. At the same time a dark elongated form shot out from above the very awning under which I was standing and landed on the langur prostrated on the ground. For a brief moment I was uncertain what was happening, but soon realized that it was the panther attacking his prey. I took quick aim and fired two shots in rapid succession. Meanwhile three more monkeys dropped to the ground and stayed similarly motionless. I switched on the light and approached the scene of the tragedy. The panther was duly killed. The other langurs strangely enough did not move but remained lying on the ground as if hypnotized. The same shot which killed the panther was also responsible for putting an end to the life of the unfortunate langur. The report of the gun, of course, attracted the servants who removed the bodies of both animals. The other langurs came to only rather slowly, and in due course moved away.

I thought much afterwards about this peculiar behaviour of langurs in the face of danger from a panther, and would put forward the following observations:

(*a*) Normally, in daylight, the langurs are generally excellent informers regarding the whereabouts of their enemies. They give instant warning and even follow their enemy's progress keeping him under continuous observation from a safe distance.

(*b*) At night, when the danger is sensed the langurs do not attempt to leave the safety of their tree, but try to locate the enemy. If the latter is not visible and yet known to be in the proximity they become very nervous and imagine the worst, that is that the enemy may have climbed the tree and be somewhere among them. This uncertainty seems to work on their nerves and produces a state of restlessness and excitement.

(c) The prolonged suspense and fear may induce a state of trance or nervous exhaustion under which the langurs are unable to control their movements.

I should very much like to hear comments on the above story and to know if similar observations have been recorded.

SANDS FORT, DHOLPUR,
RAJASTHAN, SIRDAR BHUPENDRA KUMAR
October 6, 1954.

[In a note 'How do the larger felines secure nimble prey' (Vol. 51, No. 2, p. 493) Mr. R. C. Morris describes similar behaviour on the part of langurs in the presence of panther—'a form of mass hysteria'—causing the animals actually to jump to the ground, and 'so play into the feline's paws'.—EDS.]

2. UNRECORDED SOUNDS MADE BY THE TIGER

In his Miscellaneous Note at p. 494, Vol. 51 (2) of April 1953, R. C. Morris describes a vocal sound made by the tiger which he rightly notes as not having been previously recorded.

This voice sound, without the subsequent 'chuckles', was heard by me on the night of the 19th April 1925 in the Betul Forest Division of the C.P. It was mentioned by me in the typed pages of a preliminary draft for a General Index to the Society's Journals handed to the Honorary Secretary at Bombay on the 15th April 1953. In the section dealing with the tiger there is paragraph 81, 'Voice sounds made by the tiger'. In that was noted by me, 'There is one sound which can be only heard at night, and that is the tremendous blast of sound made by a tiger when he finds his near approach to his dragged "kill" stopped by ropes to which are attached pieces of cloth . . . it can be likened to the tremendous noise made by steam being let out in an engine shed.' This noise was on that night twice repeated and was obviously intended for intimidation, though there was in it also something of surprise and alarm.

Having accepted a buffalo calf and broken the tethering rope the tiger dragged the carcase about a hundred and fifty yards below the cart road and left it in a deep cleft in a nala. Shortly after dark that evening the tiger refused near approach, having, no doubt, suspicions of the 'bird's nest' machan built in the only available and somewhat inadequate tree. In the hope that a second 'live bait' would be taken—for the tiger again passed along the road during the night—arrangements were made, and the carcase in the nala covered under leaves and brushwood, and two ropes, in which were twisted pieces of white cloth, were stretched across the nala above and below the 'kill'.

The first tremendous blast was uttered about 8 o'clock when the first rope was encountered and the second some twenty minutes later when he met the other rope. After a further interval of about the same period there was the sound of tearing away of the brushwood and removal of the carcase which it was found in the morning had been done from beneath the lower rope. Having sufficiently 'intimidated' the ropes he had no fear of them. A beat by seventy men failed to find the tiger, which was left to enjoy the remainder of his life in well-deserved peace.

c/o LLOYDS BANK LTD.,
39 PICCADILLY,
LONDON, W.1,
September 23, 1954.

R. W. BURTON,
Lt.-Col. I.A. (Retd.)

3. CAT AND MONGOOSE

My friend G.J., who frequently stays with me, has just told me the following story, which I think is worth repeating for the interest of readers:—

> 'When I was a student at Adyar, we used to take tea out in the garden at 3.30 p.m. daily. A saucer of milk was always placed on the ground close to our tea table.
>
> As soon as the rattle of cups announced the arrival of the servant bringing our tea, from one corner of the garden would come a cat and from the opposite corner a mongoose. They would reach the saucer of milk simultaneously, and each would begin to drink without taking the slightest notice of the other. As soon as the milk was finished, each animal would retire to the corner whence it had come.
>
> We never saw either animal at any other time.'

Almost with tears in his eyes, my friend concluded 'Oh! If only I'd had a camera in those days!'

G.J. is a deservedly famous actor, but I have no doubt that those almost-tears were more than almost-genuine.

LONAVLA, T. GAY.
September 29, 1954.

4. EXTRAORDINARY BEHAVIOUR OF A SOLITARY BULL BISON (GAUR)

While out on the hills (Billigirirangans, Coimbatore District) on the 7th November, I observed a solitary bull bison behaving in a peculiar manner. The scene was an open grass flat, at one end of which Sholagas (aborigines of these hills) had buried a child about a year ago.

The bull proceeded to flatten the little mound by pawing at it; and then, using its right horn like a scythe, pivoting round and round at the same time, it dug a smooth, saucer-like depression with horizontal sweeps of its horn. The Sholagas with me were astonished, and their comments instructive. After a few minutes the bull seemed to be satisfied that the deep basin it had excavated was to its liking and strolled off.

On inspecting the bison's effort it was revealed that had the bull dug a few inches deeper the poor child's remains would have been disinterred. The sides of the 'basin' were, in part, polished by the animal's horn. It is difficult to account for its behaviour. That the bull had been fighting with another solitary earlier was obvious, as we came on their battle-ground only a short distance away.

HONNAMETTI ESTATE, R. C. MORRIS
ATTIKAN P.O.,
via MYSORE,
November 11, 1954.

5. THE BROW-ANTLERED DEER (*CERVUS ELDI* MACCLELLAND)

(*With a plate*)

1. In Wild State

The beautiful Brow-antlered Deer of Asia is in danger of becoming extinct in certain parts of its habitat. The three subspecies in their respective regions of (*a*) Manipur State in India, (*b*) Burma and possibly also Malaya and (*c*) Thailand and Viet Nam deserve immediate attention from the I.U.P.N. and the Governments of the countries concerned.

The relative positions of the three subspecies in their wild state, so far as they are known to the writer, are given herewith:

(*a*) *Cervus eldi eldi* MacClelland, 1842. Found only in Manipur State in India. Locally known as *sangai.* Used to be plentiful in the old days. In 1933 J. C. Higgins wrote of it as being 'fairly common'. It was nominally protected by law, but its numbers were then declining owing to the attentions of wild dogs and poachers. In 1934 by order of the Manipur State Durbar it was resolved that no further permits be issued for shooting these deer until further orders, 'as this animal was in danger of extinction'.

Since then World War II has intervened, to be followed by unsettled conditions in the State. Unfortunately these deer are great wanderers and leave the flooded areas near the Logtak Lake in the rains and migrate to drier places. In the cold weather they return to the swamps. In 1947, G. B. Eastmure reported that he saw several in twos and threes, and two herds of about seven or eight beasts, as well as one magnificent stag. But when in 1950 Dr. Dillon Ripley looked for them, he says that he found no recent trace that *sangai* still existed. He was shown one pair of antlers said to be four years old.

In 1952 the Forest Department of Manipur State reported that all enquiries as to the existence of this deer in Manipur had proved fruitless, and it was then presumed that the animal had become extinct. In the spring of 1953 a Survey Party of the Zoological Survey of India working in Manipur searched for traces of this deer, but nothing definite could be found.

In March 1954 the writer was informed by a friend in Kohima that a police constable in Manipur had shot one of these deer (a stag) and that two others had escaped at the time of firing. This information was duly passed on to the Senior Conservator of Forests, Assam, who was about to go on tour in Manipur; and he has since informed the writer that after careful enquiries at Suganu on the south of the Logtak Lake, and at Moirang on the Bishenpur-Tiddim Road, he is under the impression that the animal still exists.

It is to be hoped that the Manipur Government will do all in their power to protect fully this fast-vanishing creature. The mere creating of sanctuaries and the passing of laws will not suffice: severe penalties for killing or attempting to kill this deer should be imposed, after full publicity has been given in the press and by other means.

(*b*) *Cervus eldi thamin* Thomas, 1918. Found in Burma, and possibly also in Malaya. Locally known as *thameng* or *thamin*. Lt.-Col. R. W. Burton has informed us that this Burmese race used to be very common in north Burma at the end of the last century. They could be seen in their thousands. In 1931, however, there were probably only about 500 left in the whole of Burma.

More recently U Tun Yin's exhaustive and commendable enquiries (*Jour. Bom. Nat. Hist. Soc.*, Vol. 52, No. 1) have revealed what appears to be an increase in the numbers of this deer in recent years. This increase must have been due, as U Tun Yin has suggested, to the strictness of the Japanese about the issue of firearms and to the shortage of ammunition during the occupation, and later to the shortage of ammunition among the insurgents.

If and when conditions in Burma improve, and if the supply of arms and ammunition becomes plentiful, the status of this deer may again become endangered, unless the Government of Burma take prompt and effective steps for its preservation.

(*c*) *Cervus eldi siamensis* Lydekker, 1915. Found in Thailand and Viet Nam. Nothing is known to the writer of the present status of this deer in Thailand and the areas formerly known as French Indo-China, or if the animal extends into Malaya.

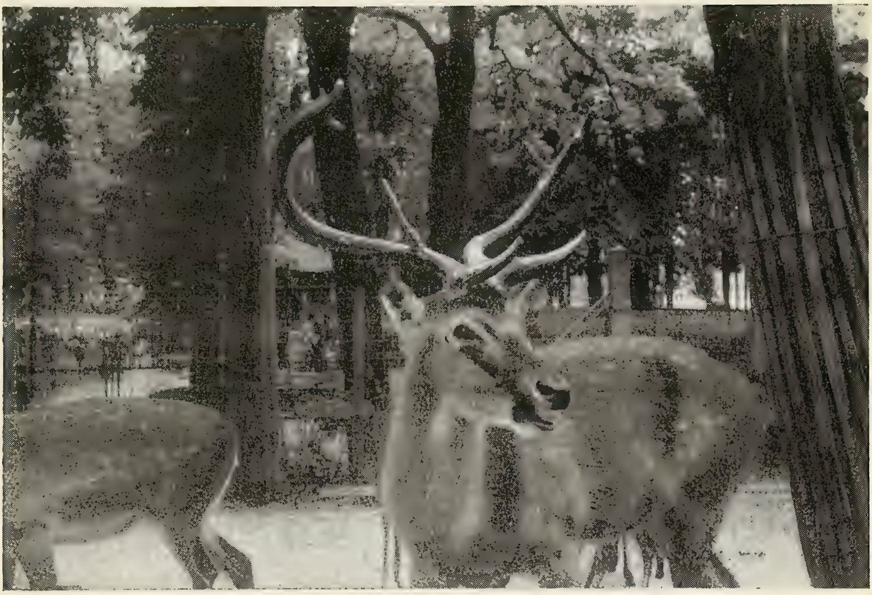
2. In Captivity

All three races of this deer appear to thrive in captivity if given proper attention. It therefore seems that all possible steps should be taken by Zoological Societies, Zoological Gardens and Zoological Parks to obtain specimens of these animals in order to prevent them from dying out. Instances of their being kept in captivity are as follows:

(*a*) *C. eldi eldi*. Deer believed to have been of this subspecies did very well in the Alipore Zoological Gardens of Calcutta, and many fawns were born, usually in the months of October, November and December. The herd only died out due to neglect during World War II. In the Regent's Park Zoological Garden of London, four fawns, possibly of this subspecies, were born during the years 1922-25. In the Duke of Bedford's Park at Woburn Abbey, a small herd of them was kept with great success, and only died out due to unfortunate neglect caused by World War I.

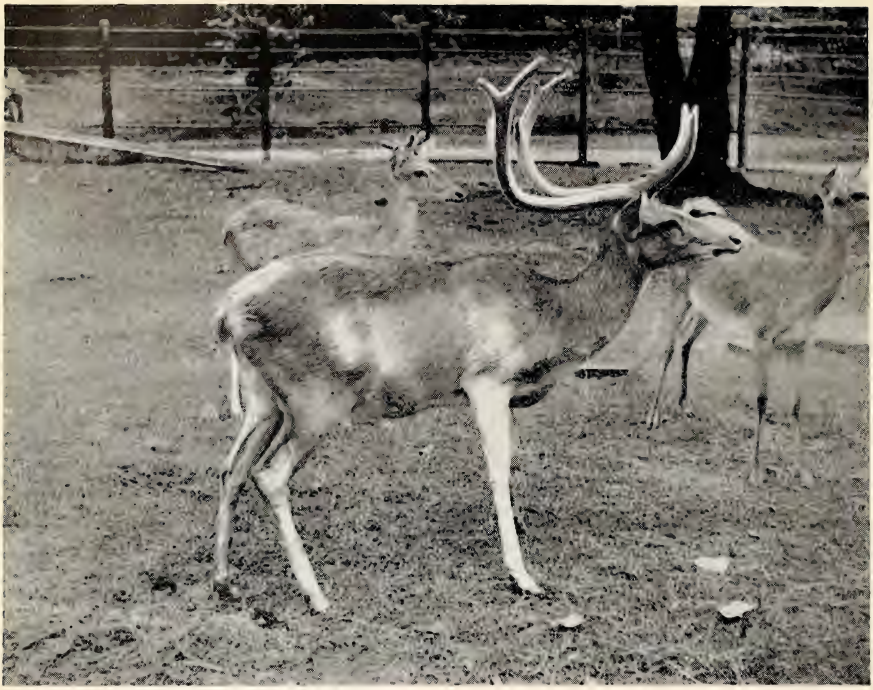
(*b*) *C. eldi thamin*. U Tun Yin has informed the writer that a pair of this subspecies was captured in the Minbu Forest Division by U Aung Din in May 1947 and presented to the Rangoon Zoological Garden. These have now increased to nine. Three more stags have been presented from various sources, making a total of twelve animals in this zoo. Unfortunately the sex ratio is unsatisfactory, being 9 stags: 3 hinds. The total number of deaths from 1947 to July 1954 was only 5 (2 hinds attacked by stag, 1 from enteritis and 2 died young).

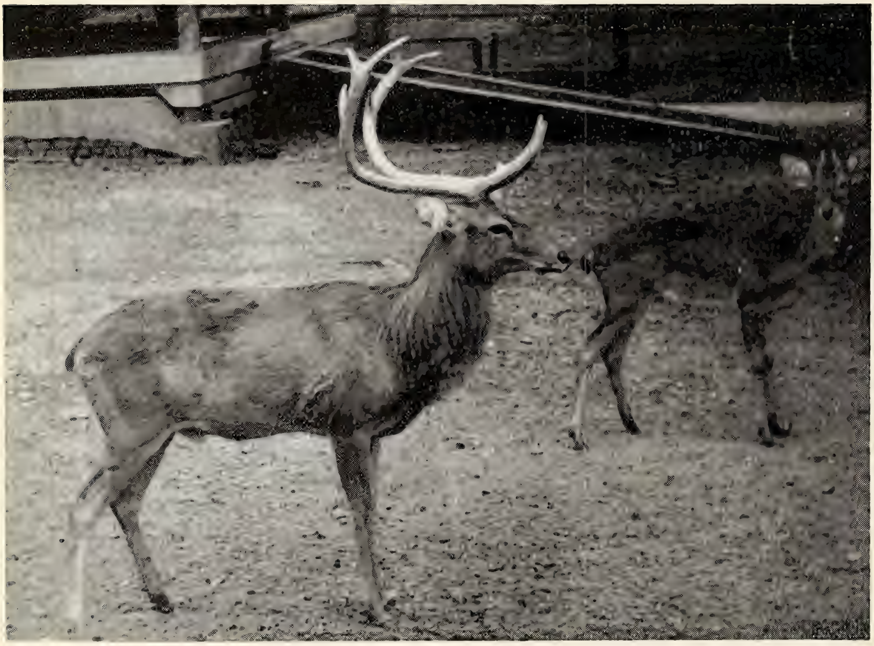
U Tun Yin has informed me that the animals of this subspecies in the Rangoon Zoological Garden are not spotted, but that he has



Brow-antlered Deer stag. Vincennes Zoo, Paris

Stag with four of the five hinds, in Vincennes Zoo, Paris
(Photos : E. P. Gee)





Brow-antlered Deer *(Cervus eldi thamin)* in Rangoon Zoo.
(Photos: Zoo staff photographer)

received a report that the animals in the Myatheindan Buddhist Monastery at Mandalay in Upper Burma are spotted. He also mentions a report that these animals have been seen with spots in the Allanmyo Forest Division.

(*c*) *C. eldi siamensis.* A pair of this subspecies reached the Vincennes Zoological Garden of Paris in 1937. The number now in existence from this original pair is eleven, of which 9 are in Paris, 1 in Lyons and 1 in Rotterdam. The nine in Paris consist of 1 stag with 5 hinds, and 3 young stags kept separate.

When the writer visited this zoo in June 1954 the animals appeared to be in very good condition, and were a very beautiful and graceful exhibit. Spots were just visible on some of the animals. The mature stag had antlers with hard horn, whereas at least two of the three young stags were seen to be in velvet (the other young stag was not seen).

The writer is grateful to M. Nouvel for information regarding the keeping of these deer in the Vincennes Zoo. Apparently 21 have died: 12 of enteritis, 5 from injuries and the rest chiefly when young and from the severity of the winter. The young are usually born in October and November. The period of gestation is 239 to 256 days. Maximum age recorded is 13 years. Stags commence to grow their antlers in August, are in hard horn in December and shed their antlers July. They mate in February.

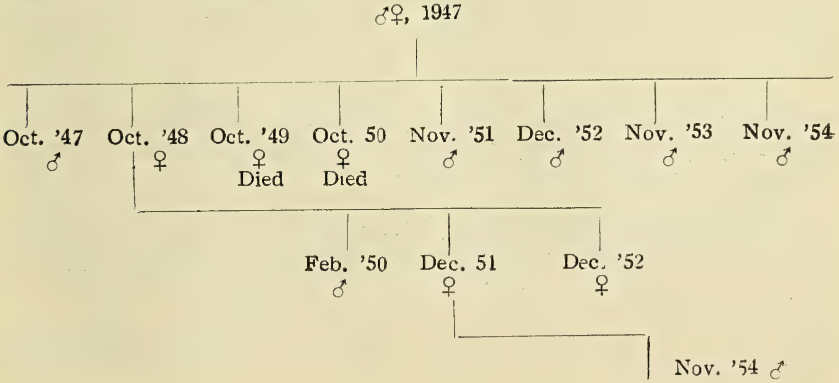
Oating P.O.,
Assam (India),
September 16, 1954.

E. P. GEE

6. THAMIN OR BROW-ANTLERED DEER IN THE ZOOLOGICAL GARDENS, RANGOON

(*With a plate*)

A pair of Thamin (*Cervus eldi thamin*) presented by the officers and staff of the Forest Department, Minbu Forest Division, in May 1947, has been breeding in the Zoological Gadrens, Rangoon, and is now in the third generation.



Two hinds were charged by the stag born in 1947 and killed. One hind born in October 1950 died of enteritis.

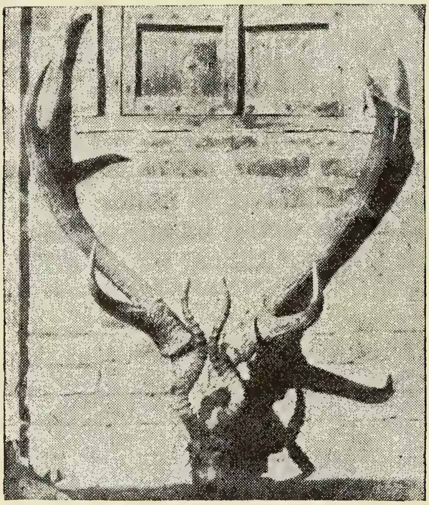
During the current year (1954), three stags were presented. There are now eleven stags and three hinds.

25, Inya Myaing Road,
University P.O., Rangoon,
December 5, 1954.

TUN YIN

7. ABNORMAL HORNS OF A BLACKBUCK (*ANTILOPE CERVICAPRA*)

(*With a photo*)



In 1918 an abnormal Blackbuck head was sent to a taxidermist in Roorkee. He had at the same time received a very big sambar head from another sportsman.

As both trophies were interesting I photographed them and am enclosing a copy of the same as it may be of interest to readers of the *Journal*. The sambar head is not abnormal, but is an unusually fine specimen.

I am unable to say where the Blackbuck was shot, but as the taxidermist was a small bazar craftsman who did odd jobs for local sportsmen it seems probable that it was shot somewhere in Uttar Pradesh or the Punjab near Roorkee.

In Vol. 6, p. 184 of the *Journal* a note by A. W. Morris, accompanied by six illustrations, describes abnormalities in the horns of antelopes, but none quite as symmetrical as the head illustrated in the photograph.

London,
January 3, 1954.

C. H. BIDDULPH

8. NOTES ON THE DESERT HEDGEHOG (*HEMIECHINUS AURITUS COLLARIS* GRAY)

Several hedgehogs were reared in the laboratory for embryological studies. One morning I noticed that one female—the sex was actually revealed only when it gave birth; it is not easy to detect the sex of a hedgehog superficially because of the dense coat of spines covering its body—was ailing; it kept itself aloof from others, and was licking its vulva with the tongue. After a little while the animal began to tremble and lay down on the sandy floor of the cage in a most unusual position: the forelimbs were fully stretched in front, the snout was extended forward on the floor; the hind limbs were kept slightly erect, so as to keep the hind quarters a little above the ground. At 8 a.m. she gave birth to one young. During the delivery the snout of the young appeared first. Seeing this one of the males (later confirmed) caught hold of the snout of the young and actually pulled the baby out of the reproductory tract. I was wondering if he was helping with the delivery, but to my surprise, the young was soon devoured by the male. The mother continued to lie thus with the hind legs also fully stretched. After five minutes, she began to search for the young. At about 8.40 a.m. she was again observed to be very uneasy. (This time she was kept away from all the other hedgehogs.) She assumed the same posture as for the first delivery. This time she was also opening her mouth at intervals. The hind limbs were shaking violently. At 8.45 a.m. we could see the head of the baby coming out; then the body followed. The limbs were folded laterally. There was a series of fairly rapid muscular contractions around the vulva for the eversion of the foetus. Each series of contractions was separated by only a few seconds followed by a rest period of variable length before the next series of contractions started. Each series of contractions lasted for 4-5 seconds. There were five violent expulsive contractions before the offspring finally came out. The young was licked when the mother recovered after four minutes. The delivery took 4.20 minutes. After recovering, the mother very softly held the baby in her jaws and kept it under her body. At 11 a.m. and 1 p.m. it gave birth to two more young and kept all the three under itself. Altogether she gave birth to four young ones in a period of five hours. No blood or any tissue matter was noticed. Thus it may be concluded that the placenta in hedgehogs is of the Deciduous type.

During the breeding season another female *H. a. collaris* gave birth to two young only. Three *H. a. collaris* were dug out from their respective burrows with two offsprings each. Last year a female *Paraechinus micropus micropus* Blyth gave birth to only one young. Another female of the latter form was dug out with two young.

The breeding season lasts from July to September, but most of the births occur in August and September.

Apparently McCann's note (*JBNHS*, 1937, 26: 616) was the only observation on the breeding of the hedgehog, *H. a. collaris* (=*Hemiechinus collaris* Gray and Hardwicke) till now. McCann concluded concerning the number of young born from his experience of abortion of some hedgehogs while in transport by car in Cutch. He mentions, 'from the premature births referred to above and disparity of age observed in the foetuses, it would appear that only one at a birth is normal.' He also mentioned that according to Dobson (*vide* F.B.I. Mammalia, p. 214), the number of young at a birth never exceeds four.

My observations, though too meagre for any conclusion about the usual number of offsprings, show that it varies from one to four in case of *H. a. collaris*. The European hedgehog, *Erinaceus europaeus*, gives birth to 1 to 7 offsprings, the 'most common' number being 5—two and three in each horn of the uterus (Deansley, R. 1934, *Phil. Trans. Roy. Soc.*, *London* 223, pp. 239-276).

Description of the Young:

The young were born with eyes closed. At the time of birth, they had only 2 mm. long spines, but after five hours these developed to 8 mm. The spines were still soft and had no fixed coloration. Some were dirty white and others black. In adult *H. a. collaris* the spines measure 30 mm.; they are largely dirty white with black tips. The young were capable of moving about in a small area of 8-10 in. They had a remarkable power of identifying their mother, and as soon as she came near all the young made a noise like *chu chi, chu chi*. The averages of measurements of the young of *H. a. collaris* are given below.

Weight	8.325 gms.
Length: tip of snout to tip of tail	47 mm.
Fore limb	26 mm.
Snout	10 mm.
Ear	5 mm.
Shank	12 mm.
Tail	5 mm.

Jaswant College,
Jodhpur,
December 6, 1954.

ISHWAR PRAKASH

9. CANNIBALISM IN HEDGEHOGS

In a recent note (*JBNHS*, 51: 730) I recorded a case of a young hedgehog being devoured by adults, but was unable to ascertain if its mother had also partaken of the meal.

This year a female *Hemiechinus auritus collaris* Gray, kept in a large cage with thick layer of sand in the bottom, gave birth to two young. She dug a burrow in which to accommodate herself together with the young and was provided with such food as hedgehogs appear to relish in captivity, i.e., meat, frogs, milk etc. On the fourth day the young could not be found in spite of a thorough search being made in the sand and it can only be concluded that they were eaten by their mother.

In my previous note I had observed that hedgehogs do not molest each other if they are properly fed, but the present note proves that in captivity at least they are sometimes inclined to eat their young.

DEPARTMENT OF ZOOLOGY,
JASWANT COLLEGE, JODHPUR,
August, 31, 1954.

ISHWAR PRAKASH

10. WILD LIFE PRESERVATION IN INDIA

THE AREA OF THE FORMER GILGIT AGENCY

It is known from the book, 'Between the Oxus and the Indus.' by Colonel R. C. F. Schomberg, published in 1935, p. 195, that while shooting was still a popular pastime it was not easy to indulge in it as nearly all animals had been killed off.

> 'There is perpetual warfare against every living animal, foxes for their fur, birds for their meat and feathers; even sparrows are pursued relentlessly by small boys with sticks and stones.'

The Ram-chukor, or Himalayan Snowcock, was trapped by a simple device as many as four or five at a time being caught.

> 'The results of this incessant pursuit of every living creature is that wild life is almost extinct in the Gilgit Agency . . . . It is distressing to wander through such country, splendid ground for ibex and markhor, and to see no sign of any wild creatures at all.'

In this connection it would be of great interest to know if any of the considerable number of *Ovis ammon poli* or Marcopolo's Sheep, which was at one time within the Hunza territory and protected by the Ruler, are still there—the only place within the former British Indian limits where the species existed. Paragraphs 51 (Kashmir) and 60 (Markhor) of the summarised index of the compilation, 'The Preservation of Wild Life in India', may be seen.

IN THE GHIZR COUNTRY, WEST OF GILGIT

Trout.—In the same book, p. 46, it is said that the Ghizr River had been stocked with English trout—the species is not mentioned—the flavour of which was loudly praised by the natives by whom the fish was largely poached, but appeared to be not only holding its own but even destroying the native fish. The Ghizr River flows eastward along approximately latitude 36°25′ to add its waters to the Gilgit River some 40 miles west of that place. This introduction of trout into the Ghizr River may be added to the localities and literature mentioned in 'A History of Shikar in India', at p. 857 *JBNHS*, Vol. 50, August 1952.

c/o LLOYDS BANK LTD.,
PICCADILLY,
LONDON W.1,
June 5, 1954.

R. W. BURTON,
Lt.-Col. I.A. (Retd.).

[No more recent data concerning the position of wild life in these areas is available. Dr. A. R. Ranjah, of Zoological Survey Department of Pakistan, through whose good offices an attempt was made to procure information, failed to elicit the desired response from the authorities on the spot.—Eds.]

11. NEW LIGHT UPON THE NATURAL HISTORY OF MALABAR

'Sir,—I have read with much interest the incident published in *The Madras Mail* of December 1, of a boar and tiger killed with a particularly lucky single shot. You will realise why I call it a particularly lucky shot when you read the following facts about boars and tigers known to, and taken advantage of by, the Malabar shikaries.

When a boar and a tiger happen to meet, they stand apart looking fixedly at each other, and each waiting for an opportunity to attack the other. For days and days they will stand like that, and nothing will disturb them. The shikaries say that when these animals are found in this state, you can approach them without attracting their attention and can even stroke the tiger without any risk of its attacking you. If nothing untoward happens the tiger falls down after a few days through sheer exhaustion, and the boar rushes towards it and tears it to pieces. When a shikari finds such a lucky meeting (lucky for him) what he does, and what he should do, is to shoot the boar—and never for his life the tiger. As soon as the boar is hit, it rushes at the tiger, and invariably succeeds in killing it. On the other hand, if the tiger is shot at and hit, that animal rushes not at the boar but in the direction from which the shot came, and woe unto the man if he be within reach, or is unprepared.

Was not the gentleman who ignorant of this instinctive peculiarity of these animals, shot the tiger, and missing it hit the boar particularly lucky.

—M. KUMARAN'

The above description of an encounter between a tiger and a boar comes from *The Madras Mail* of December 1931 and was sent to the paper by a contributor from Tellicherry on December 3, 1931.

I think it should find a place in the *Journal* as it seems extraordinary that the contributor should have so completely believed one more of the old village shikari legends that he felt he had to pass it on to fellow-sportsmen.

At this distant date I am not sure of the particular incident reported in *The Madras Mail* of the December 1, 1931, but believe it referred to a sportsman approaching a kill of some animal, seeing a tiger feeding and firing at it. The shot however missed the tiger and seriously wounded the boar, also feeding on the same kill.

The boar was reported to have attacked and killed the tiger immediately on being wounded and to the sportsman's surprise he found a dead tiger and boar when he approached the kill.

The original story, one has to admit, sounded rather hard to believe, but was easily capped by the contributor from Tellicherry.

LONDON, C. H. BIDDULPH
January 3, 1955.

12. A BIRD ANSWERING ITS OWN ECHO

The *Journal* has published several notes of birds showing strong reaction to their own reflections in mirrors and other polished surfaces, and most car-owners must have observed Robins and Wagtails pecking at their own images in chronium hub-caps. But have you any record of a bird answering its own echo?

The rains were over, and the tall trees round our house were full of bird-song. Conspicuous among the various notes was the insistent throaty call of a Jungle Crow, answering and answered by another in the distance.

Idly listening, I began to be struck by something peculiar about this exchange of repartee; and I realised that the distant crow was replying almost before the near crow had finished, and was copying every tone and inflection exactly. It was such a complete mockery that I could not help sympathising with the first crow's obviously rising irritation.

I stalked the crow as he sat in our big babul tree, and turned my gaze in the direction from which the second bird was answering. The source of the answer was perfectly clear; it came from my old cottage about 100 yds. away. I looked and looked for the second crow. *There was no second crow.*

And suddenly I remembered how I had once noted a clear echo that is thrown back from the cottage wall if you shout from a point near the babul tree. The mystery was solved. The Jungle Crow was shouting at its own mocking echo!

LONAVLA, T. GAY
January 6, 1955.

13. ANOTHER BIRD WATCHING PILGRIMAGE TO SW. TIBET

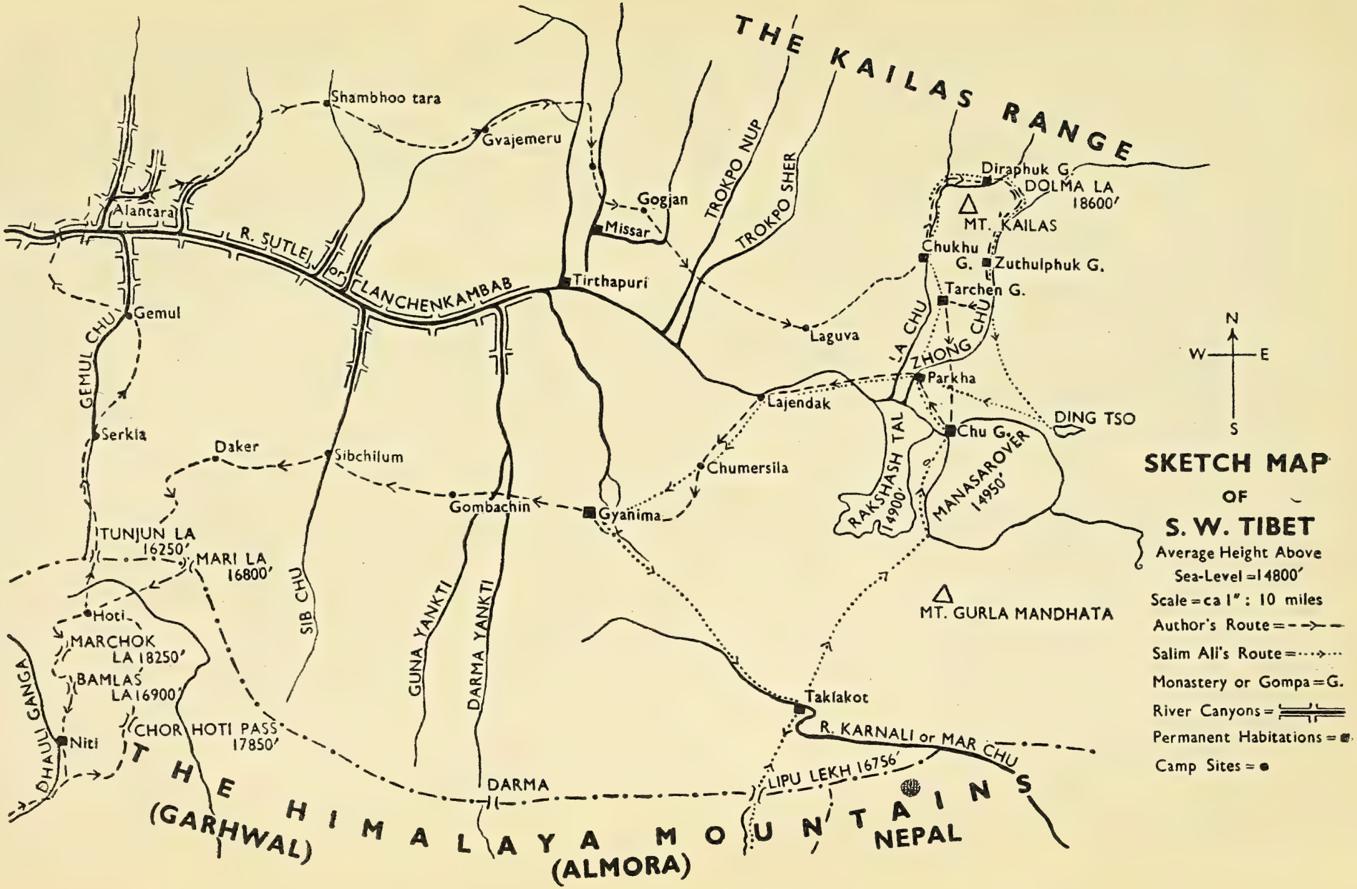
(*With a map*)

This account of my bird watching in the precincts of Mt. Kailas must be read as a supplement to the article by Mr. Sálim Ali in Vol. 46, No. 2 of this journal under the title of 'An Ornithological Pilgrimage to Lake Manasarover and Mount Kailas'. There is little I can add to his excellent account of the geography and ecological features of the country other than that I crossed into Tibet considerably to the west, from the Dhauli Valley in Garhwal whereas he followed the route across the Lipu Lekh Pass close to the western border of Nepal. Apart from the tremendous canyon regions of the River Sutlej, very like that of the famous Colorado of the U.S.A., this western route had no other features in climate or avifauna differing from those described by Sálim Ali on his eastern route. It is the fact that I was in Tibet a month later than he, that permits me to make a few additional observations on the birds of the region. The La Chu and the Zhong Chu, the two rivers on either side of Mt. Kalias which he mentions as desolate snowfields were green with grass, and even the 18,600 ft. Dolma La was free of snow. The La Chu, however, was more desolate than the other stream which was gay with flowers. The withering Tibetan gales had desiccated all the snow on the plateau and the Monsoon now banking up on the Himalayas penetrated in detached squalls of sleet and rain, both of which added to the miseries of Tibetan travel. Then, the occupation of Tibet by the Chinese and the semblance of authority by two soldiers at Parkha had reduced the bandit menace though we were careful to make the fact clear that we were well armed, whenever we met any of the local habitants. Offsetting the security of having a more settled authority in the land was the annoying fact, for the bird watcher, that the new power did not like the carrying of cameras and binoculars, as much as fire-arms, and both these valuable companions had to be left behind with the hospitable commandant of the Indian security police at Hoti. Without binoculars I missed the proper identification of many birds especially since most of them were totally new to me and nondescriptly coloured.

We crossed into Tibet over the 16,250 ft., Tunjun La on 27th June 1954 and were back at Hoti on the 16th of the next month. The accompanying sketch map of SW. Tibet shows roughly the routes taken by Sálim Ali and by my party.

Itinerary:

26-6-54. Hoti 14,500 ft. (India).
27-6-54. Crossed the Tunjun La 16,250 ft.; Sarkia *ca.* 15,500 ft.
28-6-54. Gemul *ca.* 14,000 ft.
29-6-54. Crossed the R. Sutlej *ca.* 13,000 ft.; Alantara *ca.* 13,500 ft.
30-6-54. Shambhutara *ca.* 15,000 ft.
1-7-54. Gvajemeru *ca.* 14,800 ft.
2-7-54. Misser *ca.* 15,000 ft.
3-7-54. Gogjan *ca.* 15,500 ft.
4-7-54. Laguva *ca.* 15,500 ft.
5-7-54. Nyanri Chukhu Gompa *ca.* 15,800 ft.
6-7-54. Dhiraphuk Gompa *ca.* 16,700 ft.
7-7-54. Crossed the Dolma La 18,600 ft.; Tarchen *ca.* 15,500 ft.
8-7-54. Chiu Gompa 15,000 ft., northwest corner of Manasarover.
9-7-54. Parkha *ca.* 15,100 ft.
10-7-54. Lajendak *ca.* 15,000 ft.
11-7-54. Chumersila *ca.* 15,200 ft.
12-7-54. Gyanima Mandi *ca.* 14,900 ft.
13-7-54. Gombachin *ca.* 15,000 ft.
14-7-54. Sibchilum *ca.* 14,500 ft.
15-7-54. Daker *ca.* 15,000 ft.
16-7-54. Crossed the Marhi La *ca.* 17,200 ft.; Hoti (India).


SKETCH MAP OF S.W. TIBET
Average Height Above Sea-Level =14800′
Scale = ca 1″ : 10 miles
Author's Route = - - -> - -
Salim Ali's Route = ···→···
Monastery or Gompa = G.
River Canyons =
Permanent Habitations = ■
Camp Sites = ●
N
S
E
W
THE KAILAS RANGE
THE HIMALAYA MOUNTAINS
(GARHWAL)
(ALMORA)
NEPAL
Alantara
R. SUTLEJ or LANCHENKAMBAB
Gemul
GEMUL CHU
Serkia
Shambhoo tara
Gvajemeru
Missar
Gogjan
Tirthapuri
TROKPO NUP
TROKPO SHER
Laguva
Diraphuk G.
DOLMA LA 18600′
MT. KAILAS
Chukhu G.
Zuthulphuk G.
Tarchen G.
LA CHU
ZHONG CHU
Parkha
DING TSO
Lajendak
Chu G.
RAKSHASH TAL 14900′
MANASAROVER 14950′
Chumersila
Gyanima
Gombachin
Sibchilum
Daker
TUNJUN LA 16250′
MARI LA 16800′
SIB CHU
GUNA YANKTI
DARMA YANKTI
Hoti
MARCHOK LA 18250′
BAMLAS LA 16900′
CHOR HOTI PASS 17850′
Niti
DHAULI GANGA
MT. GURLA MANDHATA
Taklakot
R. KARNALI or MAR CHU
LIPU LEKH 16756′
DARMA

NOTES ON BIRDS OBSERVED ON THE TREK

Corvus corax tibetanus. The Tibetan Raven.

Sparsely distributed throughout the high regions across the Zasker range, in pairs and singly close to encampments and monasteries. Highest seen at 18,000 ft. near the Dolma La.

Pyrrhocorax pyrrhocorax. The Redbilled Chough.

Met with on the Kailas Prakrama and with young in cliffs near Chiu Gompa, Manasarover. Very common along the Himalayas.

Pyrrhocorax graculus. The Yellowbilled Chough.

Very common at Hoti. A flock sailing overhead at Shambhutara. Not recorded either by Sálim Ali or Ludlow far into Tibet.

Podoces humilis. Hume's Ground Chough.

A pair with young in cliff-face at Hoti. Common on the Tibetan Plateau with young in Mouse-Hare burrows, holes in cliff-faces, monastery walls and in mani walls. Young fed well into dusk. Very confiding.

Tichodroma muraria. The Wall-creeper.

A solo seen on rock face above the swirling waters of the Sutlej. Also a bird carrying food to a scree above Gauri Kund 18,000 ft. below the Dolma La.

Cinclus cinclus. The Kashmir Dipper.

Seen on the Trokponup, La Chu and Zhong Chu.

Saxicola torquata. The Collared Bushchat.

A pair with young in nest at Misser on edge of wet grass.

Oenanthe deserti. The Tibetan Desert Chat.

Pairs and solos throughout Tibet. Breeding at Hoti, in the canyons at Alantara, and Laguva. Also among the deserted huts at Gyanima Mandi carrying food to young in nest.

Phoenicurus ochrurus rufiventris. The Eastern Indian Redstart.

Very common throughout Tibet near cliff-faces and steep banks of rivers. Most of the birds had young following them. A couple of pairs carrying food for young in nest at 18,000 ft. near the Dolma La. Freely entering the monastery at Tarchen. The male has a peculiar song which sounds like paper rustling. At times also uttered by the female.

Phoenicurus grandis. Güldenstadt's Redstart.

A pair at 18,000 ft. near the Dolma La with young out of nest, and a bird carrying food to a scree higher up. A solo at Hoti at 16,500 ft., 17th July. Not recorded by Sálim Ali. Ludlow obtained a specimen in September 1932.

Calliope tschebaiewi. Tibetan Rubythroat.

Common among *Caragana* throughout Tibet. Sálim Ali puts this bird down as *C. pectoralis* though he mentions the possibility of his being mistaken. However, all the birds seen by me appeared browner than the Himalayan birds. On the other hand I cannot be absolutely certain and base my assumption on Ludlow's identification.

Laiscopus collaris. The Alpine Accentor.

This common Himalayan bird was met with only on the Kailas Prakrama. A pair carrying food below the Dolma La. Not recorded by Sálim Ali. Ludlow obtained a specimen near the Lipu Lekh Pass September 1932.

Prunella rubeculoides. The Robin Accentor.

Generally met with throughout Tibet on the edge of snow-fed streams and wet grass. Nesting in the bordering furze. All nests contained young—three or four. Also around Kailas and on the Dolma La at 18,600 ft. Feeding young late into dusk. Very confiding.

Phylloscopus affinis. Tickell's Willow Warbler.

Breeding in *Caragana* at Sarkia, and elsewhere. Mostly young in nest.

Carpodacus rubicilla. The Great Rosefinch.

A few birds seen in furze bushes near Tarchen.

Carduelis caniceps. The Goldfinch.

Seen in parties at Gemul-Alantara on grass bordering streams at the bottom of the canyons.

Acanthis flavirostris. The Twite.

Met with in parties in similar type of country to the Goldfinch. Also near Zuthulphuk Gompa.

Fringillauda brandtii. The Mountain Finch.

Large flocks at Misser feeding on the ground near water, along with the Short-toed Lark.

Montifringilla nivalis. The Tibet Snowfinch.

Seen around Kailas. Met with well above 18,000 ft. Breeding.

Montifringilla ruficollis. The Rednecked Snowfinch.

Very common locally north of the Sutlej, near banks of streams. Young following parents.

Ptyonoprogne rupestris. The Crag Martin.

Seen on the Sutlej. Presumably breeding.

Motacilla cinerea caspica. The Eastern Grey Wagtail.

A male seen on the Sutlej near the bridge. Not recorded previously.

Motacilla citreola. The Yellowheaded Wagtail.

A breeding pair at Misser.

Otocoris alpestris elwesi. Elwe's Horned Lark.

Very common and breeding throughout Tibet. Mostly with young in nest. A pair followed by young on windy uplands near Misser.

Melanocorypha maxima. The Longbilled Calandra Lark.

Large numbers breeding on the marshy pastures at Galdungi and Gyanima Mandi.

Calandrella acutirostris. The Short-toed Lark.

Common everywhere. Especially on the great Parkha plain. A nest with three eggs, under the shelter of a furze bush.

Athene noctua. The Tibet Owlet.

Singly or in pairs on sandy *Caragana*-studded plains. Not recorded by Sálim Ali. Ludlow saw one at Tarchen, September 1932. Behaviour similar to our Spotted Owlet (*A. brama*).

Gypaëtus barbatus. The Bearded Vulture.

A pair seen at Dhiraphuk Gompa, and a solo near Chiu Gompa, Manasarover.

Falco peregrinus. The Peregrine Falcon.

A solo at Misser.

Falco subbuteo. The Hobby.

A pair seen near Misser at 15,000 ft.

Cerchneis tinnunculus. The Himalayan Kestrel.

Widely separated solos and pairs throughout the region.

Aquila rapax The Tawny Eagle.

A solo on the Parkha plain. Identity doubtful.

Haliaëtus leucoryphus. Pallas's Fishing Eagle.

Perched singly on the ground on the Parkha plain near the various streams that meander across it. Fairly common.

Buteo rufinus. The Longlegged Buzzard.

Sparsely distributed throughout the area, singly and in pairs. Mostly the dark phase.

Buteo lagopus. The Roughlegged Buzzard.

A solo in overhead flight on the Parkha plain. It is not possible to be very certain about the identity of birds of prey unless specimens are collected.

Accipiter sp. The Sparrow-hawk.

Seen on several occasions on the high plains, sailing overhead.

Columba rupestris. Turkestan Hill Pigeon.

Common everywhere on the Tibetan side of the Zasker range and on the Tibetan Plateau. The canyon-faces of the Sutlej and adjoining streams provide nesting sites for these birds. Large numbers flighting to and from Tibetan cliff dwellings above Alantara. These dwellings are occupied by shepherd families in winter and are deserted in summer. They consist of extensive caves carved out in the cliffs.

Streptopelia orientalis. The Rufous Turtle Dove.

A pair in flight at Misser. Possibly on migration.

Syrrhaptes tibetanus. The Tibetan Sandgrouse.

Common on the high plateau in pairs and small parties up to a dozen birds. Seen at Laguva where a female allowed approach to within few feet while on a nest scrape. Also at Gyanima Mandi.

Tetraogallus tibetanus. The Tibetan Snowcock.

Heard at Shambutara, Gvajameru, and in the Kailas area. The birds most probably belonged to this species.

Grus nigricollis. The Blacknecked Crane.

In pairs on the margins of the large river pools near the source of the Sutlej at Lajendak, and on the marsh at Gyanima. No nest noted.

Larus ridibundus. The Blackheaded Gull.

A few birds noted among the large flocks of the Brownheaded species, on the Parkha plain. Possibly on migration north?

Larus brunnicephalus. The Brownheaded Gull.

Large flocks on the Parkha plain and at Chiu Gompa, Manasarover. They attend on the herds of yak grazing on the extensive plain, and from time to time 'ball' up into the air as the swifts do, uttering soft caws.

Larus fuscus. The Herring Gull.

A single bird among flocks of other gulls on the Parkha plain.

Sterna hirundo. The Tibetan Tern.

Met with in pairs and parties on streams flowing across the Parkha plain, Misser and Chiu Gompa, Manasarover, Lajendak.

Cirrepedesmus mongolus. The Lesser Sand-plover.

Pairs on the plateau and on margins of bogs. A pair did the broken wing trick on a windy pass west of Mt. Kailas. Possibly had a nest or young in the vicinity. The fierce wind discouraged an investigation.

Tringa ochropus. The Green Sandpiper.

Several birds on the tundra bogs at Gyanima. Sálim Ali did not record it in June. Ludlow saw one at Chiu in September 1932.

Tringa erythropus. The Dusky Redshank.

A solo on the Trokpo Nup and a pair at Lagua. I did not meet with the Redshank *T. totanus* which Sálim Ali found breeding on the Ding Tso.

Anser indicus. The Barheaded Goose.

Very common on the Manasarover at Chiu, and feeding on the Parkha plain with the Brahminy Duck. A pair of geese seen flying north near Laguva early in the morning. Not having stayed long at Manasarover it was not possible to study them more carefully. Very confiding. The porters from Garhwal told us that large flocks of these 'hans' fly along the Dhauli Ganga Valley towards Tibet in March and April. Possibly these river valleys and the passes at their head are used as flight routes across the Himalayas.

Casarca ferruginea. The Brahminy Duck.

Very common on the Manasarover, breeding in the cliffs over the warm springs at Chiu Gompa. Also at Lajendak, Gyanima and the Parkha plain. The birds had apparently not begun to lay, for they were all walking around on the ground or flying in pairs up to the cliff faces calling all the time.

Anas streperus. The Gadwall.

A party on the warm springs near Chiu Gompa. A large number of duck were noted on the Manasarover, but without binoculars it was not possible to identify them.

JASDAN, SAURASHTRA, K. S. LAVKUMAR
November 1, 1954.

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14. HAS THE CUCKOO A PROTRUSIBLE OVIPOSITOR?

The old controversy of how the cuckoo lays in apparently inaccessible nests without destroying them is a problem which has not yet been solved. Several explanations have been put forward in an attempt to solve the point, but these have been far from wholly satisfactory. Musing over the subject for some time, and recalling the well-known instance of the Surinam Toad, the idea struck me that, possibly, during the breeding season the cuckoo develops an elongated, protrusible oviduct which enables it to perform such feats. If this were so, it would not be difficult to understand how such apparently inaccessible nests become available to the bird.

Such a possibility does not appear to be beyond the bounds of probability. I am not aware that such a suggestion has been put forward before. I have not come across it in literature. Although the idea may at first sight appear rather fantastic, it is perhaps worth while pursuing the subject. Unfortunately, geographical considerations prevent me from pursuing the subject in the field and in the laboratory. Perhaps some of our more enthusiastic members who are more fortunately placed could verify the suggestion.

DOMINION MUSEUM,
WELLINGTON,
NEW ZEALAND,
November 26, 1953.

CHARLES McCANN, F.L.S.

[We believe the possibility of a protrusible ovipositor enabling the female cuckoo to lay in a closed or 'inaccessible' nest has already been mooted before and negatived by morphological investigation. Although it is now generally accepted as almost proven that cuckoos do not deposit in a nest otherwise than by direct application of the cloaca to the entrance hole, a letter written many years ago by a British observer of some repute—salvaged from oblivion and presented by H. R. Tutt at the recent XIth International Ornithological Congress at Basel—has certainly helped to resuscitate a certain amount of doubt in the matter. The writer of the letter produced quite plausible circumstantial evidence from 2 marked fresh cuckoo eggs, originally found in a deserted moorhen's nest and subsequently discovered in 2 different nests of reed warblers some distance away, that the cuckoo sometimes does lay its eggs outside and transport them later—obviously in its bill—to eligible nests of its normal fosterers. If this account can be taken at its face value, then there would seem no obstacle to conceding that the cuckoo may sometimes place its egg in an 'inaccessible' nest by means of its bill, as was once widely believed to be the case.—EDS.]

15. MATING OF PARTRIDGES

On page 11 of 'British and American Game Birds' (Eyre and Spottiswoode, London, 1945) appears the following extraordinarily courageous pronouncement by one of the sectional authors, Major Hugh B. C. Pollard:

> 'The sexual union of any species of partridge is not generally seen. It is done in the air and is over in a flash. It is a very good test of the credibility or otherwise of anyone who chatters about birds to draw him out gently about this sexual act of partridges.

If he says he has seen a cock treading a hen you can write him off as an unreliable witness!'

As this statement seemed so supremely novel and fantastic, we wrote to the author asking if we had not perchance misread it. In reply he said:

> 'Yes, it is true and has been observed by game farm owners trying to breed penned partridges. The contact is very short but no other takes place! Sir Trevor Wheler (?) Bart, of the Emsworth Game Farms discussed it with me many years ago, and his old keeper said that he had often observed it with wild grey partridges, but not with the "French" partridge. I have asked endless keepers if they had ever seen partridges in copulation and all say they never have. Many appear to have seen these aerial connections, but not to have realized what was taking place.'

To make assurance *trebly* sure, we asked 3 experts for their views on the staggering statement in the book: Dr. Satya Churn Law of Calcutta, the foremost Indian aviculturist, Col. R. Meinertzhagen, the eminent British ornithologist, and Mons. Jean Delacour, the celebrated ornithologist, aviculturist and monographer of 'Pheasants of the World'. All three of them, unfortunately it seems must now be written off as unreliable witnesses since they maintain it is fantastic to suggest that partridges do not mate like any other game bird, and only that, in fact, has been their experience with various species of partridges and closely related game birds!

As to the aerial copulation of partridges, therefore, we here have another case of a perfectly good story, being completely spoilt by eyewitnesses!

114 APOLLO STREET,
BOMBAY 1, EDITORS
December 30, 1954.

16. THE BONE-DROPPING HABIT OF THE LÄMMERGEIER

The Lämmergeier's (*Gypaëtus barbatus*) habit of dropping bones and turtles to break them, for the sake of the contents, is well established in the literature. Perhaps the oldest account is Pliny's (in Newton) 'of having caused the death of the poet Aeschylus, by dropping a tortoise on his bald head, mistaking it for a stone' (1). Reference to this habit also occurs in such standard works as those of Stuart Baker and Sálim Ali who says: 'Its method of smashing bones is well known. The bird carries a large bone in its claws up to a height of 200 or 300 ft. and drops it on the rocks below. This is repeated again and again, if necessary, until the bone splinters, whereupon the bird alights to pick up and swallow the pieces' (2).

Meinertzhagen in his 1954 *Birds of Arabia*, p. 361, has raised the question as to whether or not the Lämmergeier ever drops bones to break them for food. During Meinertzhagen's extensive travels in Lämmergeier country he has never seen this habit. He suggests that it is more likely that this vulture, which prefers bones to meat, when carrying off a large bone and in trying to deal with it in the air, drops it accidentally and swoops down to pick it up again.

Despite the prevalence of the idea, I have found only one first-hand account in the literature. Verner describes seeing one bird once, dropping a bone from an altitude of 1,500 ft. onto a rocky hill, flying down, and feeding on it (3).

Rocky areas strewn with broken bones, said to be feeding places of the Lämmergeier, are well known to local people in parts of the Lämmergeier's range, and Moreau and North describe such a site in Kenya (4).

I have lived in Lämmergeier country. This species of vulture is one of the commonest around Mussoorie, U.P., India. During more than 20 years there I only once saw a Lämmergeier dropping a bone. My son and I were on the Tehri Road several miles beyond Mussoorie on December 20, 1950. Near Jalki we noticed a young Lämmergeier a short distance below us, carrying a large, bare bone in its talons. The steep hillside, which towered above us and dropped off rapidly below us, was covered with short, dry grass. In the fold of the hill was a shallow ravine filled with boulders. The bird glided rapidly towards us, dropped the bone on the rocks, circled once and alighted. It grasped the bone, flew around and repeated the process. A third time the Lämmergeier simply dropped the bone on the rocks and sailed away behind the hill out of sight. The distance the bird dropped the bone was between 150 and 250 ft. As far as we could see, the bone was not broken.

Apparently the Lämmergeier does sometimes drop bones for feeding purposes, but apparently the habit is rarely observed. It may be a common habit in a part of the bird's range, rare or absent in others. Observations on the occurrence and frequency of this habit in the Himalayas and elsewhere, if it does take place, and the purpose if any, i.e. accidentally, for marrow, for fragments of bone, are obviously needed.

CHICAGO MUSEUM OF NATURAL HISTORY,
CHICAGO, ILLINOIS, ROBERT L. FLEMING, Ph.D.
November 15, 1954.

[Sálim Ali has twice observed this bone-dropping habit in the Western Himalayas. In one case, the Lämmergeier after repeatedly dropping the bone on rocks from a height of about 300 ft. and swooping down to pick it up again, gave up and moved off. In the other case after several drops of what was evidently a small cow's femur the bird alighted on the ground, walked about with the gait of a

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1. Newton, A. (1893): Dictionary of Birds, footnote, p. 503.
2. Sálim Ali, (1949): Indian Hill Birds, pp. 161-162.
3. Verner, W. W. (1909): My Life Among the Wild Birds of Spain, p. 434.
4. North, M. E. W. (1948): Ibis, (Vol. 90), p. 140.

Neophron vulture and picked up and swallowed a splinter of dry bone.

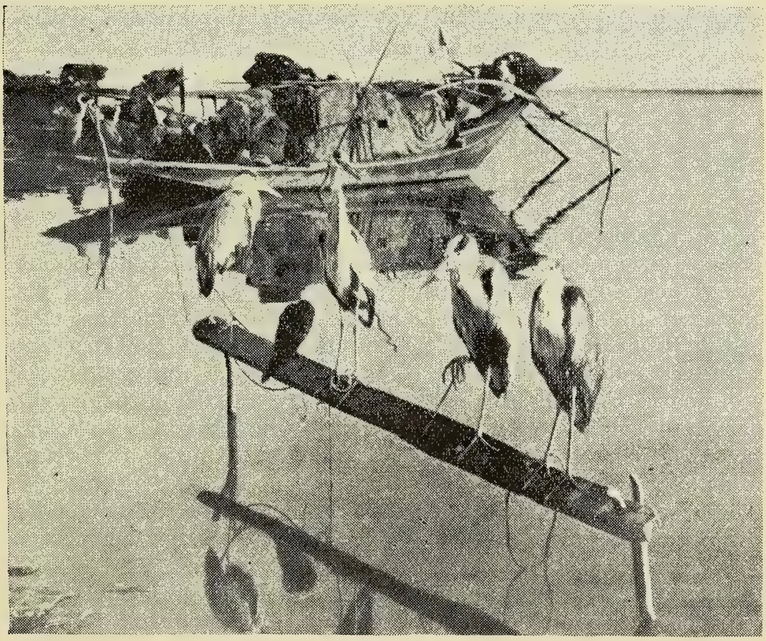
C. H. Donald (*JBNHS*, 18: 913) describing this habit says, 'I watched one in Kashmir for the better part of an hour, and during that time the bone must have been dropped quite fifty times, but remained unbroken when I left the place'.

Jerdon found large bones and the hoof of an ibex inside a Lämmergeier, but considering the number of apparent failures, it needs to be investigated more carefully to what extent the bone-dropping habit is responsible for the bird's normal food supply.—Eds.]

17. HERON-KEEPING ON THE INDUS RIVER

(*With a photo*)

The enclosed photograph was taken by Mrs. Dorothy Mackay the wife of the archaeologist who investigated the early Indus civilizations in such detail, on the Indus, probably at Mohenjo Daro. It is published by the courtesy of the Curator of the Pitt Rivers Museum, Oxford.



At first I thought that I had come across a unique instance of Grey Herons (*Ardea cinerea*) being used to catch fish, but it now appears that the birds were domesticated for another purpose.

Macpherson notes on p. 214 of his 'History of Fowling' (Edinburgh, 1897):

> 'Mr. Hume observes that hundreds of Grey Herons can be observed about every fishing village in Sindh. These tame birds are blinded by the edges of their eyelids being sewn together. They are usually tethered, a string being attached to the shank of each bird. Even the lovely Great White Heron (*Herodias alba*) and two smaller species of Egret share the same fate. The birds are kept on the fishing boats. When required for the purpose of acting as decoys, the captives are tied to stacks of wood which float in the water, or to poles set in the shallows to serve as perches for them.'

The manner in which birds attracted to the decoys were captured is not specified.

Fisheries Office,
P.O. 72, Lusaka,
N. Rhodesia,
July 24, 1954.

P. I. R. MACLAREN

[According to information supplied by an official in West Pakistan, 'Herons' are actually also used for fishing in shallow water. They are said to catch fish upto 6 inches in length for the *mohanas'* (boatmen) home consumption, not commercial purposes. We had not heard before of herons being thus used.—Eds.]

18. TRAPPING BIRDS FOR RINGING

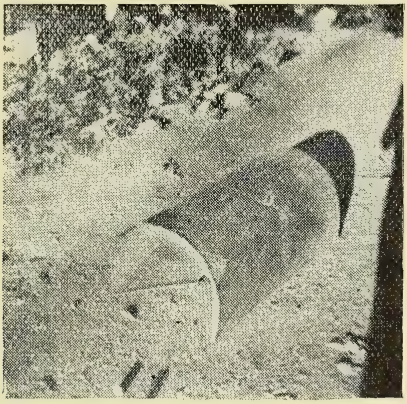
(*With a photo*)

I am interested in ringing birds in our garden at Andheri and at Pali Hill, and have tried out several types of contraptions for trapping them.

Some of the traps described in the pamphlet 'Trapping methods for Bird Ringers', published by the British Trust for Ornithology, have proved quite effective for birds that feed on the ground. With the ordinary Fall Trap of the type illustrated on page 19, we managed to catch a Magpie Robin, a White Wagtail, a Myna and a few jungle babblers. The baits used were pieces of bread and 'ghatias'.

The disadvantage of this trap is that one has to remain behind the scene at all times ready to release the trip when the birds come under it.

A more satisfactory affair is the automatic trap illustrated on page 4 of the pamphlet, and I enclose a photograph of the one which I am using. During December and January last year we succeeded in catching quite a dozen babblers, several of them being caught again and again. One bird seemed to have acquired the trap habit, and we caught it three times during the same day. These birds have a pugnacious temperament and peck viciously, but immediately they are placed on their backs in the hand they appear to be quite hypnotised and remain motionless until they are turned over, or thrown up in the air.



In this trap I was lucky in getting two Ashy Wren-Warblers and one Tailor Bird last week in Andheri. On the first day I found two Ashy Wren-Warblers flapping furiously in the trap to get away. Unfortunately owing to my clumsiness I succeeded in ringing only one bird, and the other got away from the gathering cage. The next day, however, I again found two Ashy Wren-Warblers in the trap in company with a Tailor Bird. One of the warblers got away again, but I banded the Tailor Bird and one of the warblers. Incidentally there was no food in the trap and it is difficult to imagine why the birds went in at all.

The crow trap of the type illustrated on page 7 has proved completely ineffective for our crows. Batches of them fly over the trap cawing at the decoys from a distance, but are not tempted by the pieces of meat, bread, etc., kept to attract them.

c/o Dynacraft Machine Co.,
Ismail Building,
Hornby Road, Fort,
Bombay 1,
February 29, 1952.

ZAFAR FUTEHALLY

19. THE RECORD INDIAN CROCODILE

In reference to crocodile measurements [Miscellaneous Note 17, Vol. 52 (1): 213] it is of interest to refer to the note, 'Some Measurements of the Estuary Crocodile (*C. porosus*)' contributed by the Curator, Sarawak Museum, in 1930 (Vol. 34: 1086).

From the long list of measurements given it is found that the body length is a little more than seven times that of the head. From this we know that Major Foran's method of calculation is about correct, and the skull of length 33½ in. came from a crocodile of about 19 ft. 6 in. The Elgin Museum skull of 37 in. length reported by Dunbar Brander in Vol. 34: 584, will have been taken from a crocodile of approximately 21 ft. 7 in., not 27 ft.

The longest crocodile (Gavial) on record in the Society's *Journal* is the 21 ft. 6 in. specimen shot in the Gogra River as reported by Pitman (Vol. 30: 703, 1924).

Age of Crocodiles

On the basis of the rate of growth of the mugger (*C. palustris*) as given by D'Abreu (Vol. 38: 282) the age of the 21 ft. 6 in. or 7 in. reptiles referred to above will have been about 60 years. To what age the crocodile attains, and for how long after the age of 60 increase of length continues does not appear to be known.

c/o Lloyds Bank Ltd.,
39 Piccadilly,
London W.1,
December 15, 1954.

R. W. BURTON,
Lt.-Col. I.A. (Retd.).

20. SOME NOTES ON *RANA BEDDOMII* GÜNTHER, WITH AN EXTENSION OF ITS RANGE

In the Fauna of British India and Boulenger's 'Monograph of the Frogs of the Genus *Rana* of Southern Asia', (*Rec. Ind. Mus.*, 20: 114-116), the distribution of *Rana beddomii* is given vaguely as 'Forests of Southern India'. The types of the species are also from three different parts of its distribution namely: (i) Sivagiri Hills in Tinnevelly District, Madras Province, (ii) Annamalai Hills on the Madras-Cochin border, and (iii) Malabar.

In May 1953, on our way to Goa we obtained 4 specimens (3 males and a female) of *Rana beddomii* on the Anmode-Londa Road in North Kanara. These were taken from among dry leaves by the side of a stream in heavy forest. All were pale in colour with dark patches behind the eyes (similar to colour-pattern (ii) mentioned hereunder). The enlarged gonads of the three males indicated that they were breeding. In addition to the enlarged pad on the inner side of the first finger, mentioned by Boulenger (1920) as a secondary sexual character, they had on the ventral side of each femur a granular oval-shaped swelling occupying most of the area between the vent and the knee joint.

Later, during a short visit to Mahableshwar, 4,500 ft., Satara District, Bombay (31st October to 2nd November 1954) H.A. found this species extremely common on, and under, rocks in flowing streams, many of which held a luxuriant growth of *Ammania floribunda*. In the field it appears very like *R. leithii* (common at Panchgani, 4,300 ft., 10 miles eastwards), but *R. beddomii* keeps more to the wet rocks and flowing water than *leithii* which is often found in grass at the top of hills or alongside hill-streams.

It was frequently seen during the day but was more abundant at night, and appeared to occur in three strikingly different colour patterns:—

(i) The commonest was dark above, very similar to *R. leithii.*

(ii) A less frequent pattern was paler with dark patches behind the eyes (similar to breeding specimens from North Kanara).

(iii) A relatively rare colour pattern was dark brown or almost black above, with a white vertebral streak extending from the snout to the posterior end of the body. There was often a small white square blotch on the top of the head.

None of these colour-patterns were restricted to one sex, and all the frogs had varying shades of reddish-orange on the underside; above and below the knee joint this colour was, however, not noticed in the specimens from North Kanara). No specimens larger than 40 mm. from snout to vent were obtained. The gonads were quiescent and the males had neither of the two secondary sexual characters noted in Londa specimens.

The stomach held remains of insects including Gryllids (*Oecanthus* sp.), Reduvid Bugs and Carabid beetles. One stomach held the mangled remains of a *Philautus*, probably *P. bombayensis*.

The same streams in which these frogs were found held numbers of *Nyctibatrachus humayuni.* and *Rana temporalis*, as also the tadpoles of the former. Chari and Daniel have already expressed the opinion (*JBNHS*, 51: 514) that Annandale's record of tadpoles of *R. beddomii* from Khandala (*Rec. Ind. Mus.*, xx, p. 116) must be in error for *leithii.*

On 23rd July 1953, H.A. took a solitary tadpole in a shallow sandy-bottomed hill-stream facing the Lingmala Falls at Mahableshwar, which Dr. J. L. Bhaduri, who kindly examined it, cannot distinguish from the tadpole of *R. leithii.* McCann (*JBNHS*, 46: 405) records *Rana leithii* from the same area, but attention has already been drawn (*JBNHS*, 52: 635) to his mistaking a *beddomii* from Gersoppa for this species. We have visited both Panchgani and Mahableshwar on several occasions and the abundance in which we found the adults of *leithii* at Panchgani and of *beddomii* at Mahableshwar, coupled with our failure to find the former at Mahableshwar and the latter at Panchgani, inclines us to believe that the two species do not occur together in the same localities (i.e. they are allopatric), and to suggest that it is perhaps not possible readily to differentiate between their tadpoles. Further work is, however, necesssary before this can be asserted conclusively.

BOMBAY NATURAL HISTORY SOCIETY,
December 15, 1954.

HUMAYUN ABDULALI
J. C. DANIEL

21. PRESUMPTIVE EATING OF A KRAIT BY SCORPIONS

In an attempt to study the effects of different insecticides upon scorpions a considerable number were collected and kept in cages, two in each. A 7-in. krait, *Bungarus caeruleus*, was placed in one such cage and the following morning found missing, though the cage was closed and there was no possibility of escape.

Both the scorpions were dissected for an examination of their digestive tracts, and pieces of some hard and soft material (vertebrae and skin) were found in their guts, especially in the stomach and rectum. This appears to be good evidence of a poisonous snake being eaten by a scorpion *Buthus* sp.

Department of Zoology, ISHWAR PRAKASH
Jaswant College, Jodhpur, K. C. DAVE
August 31, 1954.

22. A GRATEFUL SKINK

About 6.30 p.m. on the evening of 21st September, as I walked through my garden, I noticed a Skink (*Mabuya* sp.—subsequently measured to be 10½ ins. long) feebly trying to clamber out of a half-filled water tank. She was almost at her last gasp.

I lowered my open right palm into the water close to her. She gratefully struggled on to it, and keeping my hand spread open, I gently lifted her out of the water. She was cold, heavy and sodden, and from time to time she brought up small quantities of water that she must have swallowed in her struggles. I did not touch her with my other hand, but left her to recover through the warmth of the palm on which she lay, head on my wrist and long tail tapering away beyond my finger-tips.

I walked all round the garden, giving instructions to my Malis, and as darkness came on I went indoors and sat in my large warm kitchen. All this time the Skink never moved, though I could feel her growing drier, warmer and lighter, and almost see the sparkle come back into her bright little eyes. Presently her tongue began to flick in and out, and she slowly moved a couple of inches higher up my wrist. I kept my hand open as from the first, but freely tilted it and freely raised and lowered my whole arm.

At 8.30 I called for my supper, which I had to eat left-handed.

At 9.0 I began to stroke my guest, gently but firmly, along her back. Still she made no movement, although by now obviously fully recovered, except to lick my finger when I placed it close to her mouth.

At 9.15 I carried her upstairs to my sitting-room and gently forced her off my hand into a piece of hollow bamboo, which she made her headquarters for the next few days. When I next saw her, she scuttled away from me in the normal fashion.

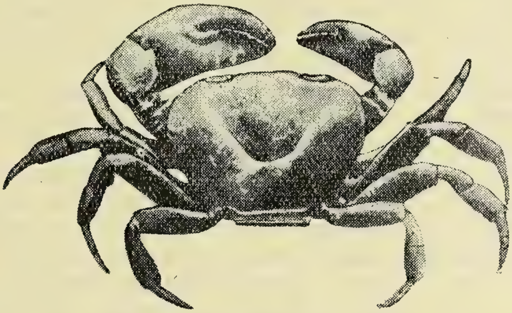
I do not know whether such fearless and trustful reaction on the part of reptiles is of frequent occurrence. In my own experience it is unique, although the snakes which I handle always lie passively in my hands until I set them down at what my daughters consider a 'safe' distance from the house.

Lonavla, T. GAY
September 29, 1954.

23. HUNTING THE LAND CRAB [*PARATELPHUSA GUERINI* (M.-EDW.)]

(*With a text-figure*)

Is he a friend, a foe, or a fifty-fifty? On the answer to this question must depend our treatment of this inmate of our farm. The answer is important, for the land crab forms a major part of the animal population of all farms within thirty miles or so of the west coast of India. Mr. McCann in his article in the Bombay Natural History Society's *Journal* (Vol. 39, p. 531) thinks the crab is unnecessarily maligned. He even thinks the crab is to some extent the cultivator's benefactor.



Paratelphusa guerini (M.-Edw.)

I had come to live in Chembur with an open mind, 30 years ago. My experience in my garden soon convinced me that the crab and I could not live peacefully together. In the first year in June I planted a number of vegetables and papayas. As soon as the seedlings came up to a height of two or three inches, they were snipped off. I sowed again and replanted papaya seedlings. At the end of the rains, I had only 10% of my seedlings left. The only vegetables I could get from my labours was *tendli* (snipped off often, but strong enough to go on producing new tendrils), and a few brinjals. Cold season flowers and vegetables sown in September and October met with the same fate. Only the seeds sown late in November or in December survived, and even these not without casualties. Whether crabs do considerable damage to paddy or not is uncertain. I have seen very considerable damage to seedlings, and to plants along the bunds of fields, but what the overall damage to the crop is, it is difficult to estimate in the absence of statistical research. I have been growing fields of mango seedlings, and amongst these my estimate of the damage is 15 to 20%. With this experience behind me, it is no wonder I feel no love or friendliness for the crab. At the end of my first year I burnt with a desire to exterminate this pest.

There is another direction in which the crab is our enemy, *par excellence*. In parts of my farm, I had to prepare raised irrigation channels. These were continuously pierced by this enemy and water leaked out and reached wrong places. Daily patching and repair was necessary, and took much time and labour. I was interested in another farm where a seven-foot high bund kept back the sea water. It was a mile long and had cost a huge sum. Was it able to give the needed protection? The piercing of the bund by crabs made the bund almost useless and the annual repairs cost several thousand rupees. Is the crab my friend? Can I love him?

Mr. McCann thinks there are a number of benefits the cultivator receives from the crab. He mentions two particularly, and in both there is an error, I think. (*a*) He thinks that on death the crab enriches the soil with lime from its shell. As the crab had previously taken the lime from the same soil, he cannot be said to enrich the soil. (*b*) He suggests that the crabs, by burrowing in the soil, serve the same useful purpose as the earthworm. As the crab holes are mostly in field bunds, or along the banks of nallahs, the fields derive very little benefit from their digging.

We are therefore driven to the conclusion that the crab is neither a friend, nor a fifty-fifty. He is enemy pure and simple. The farmer must exterminate him by whatever means possible. There is no safety for seedlings for a period of six months every year unless the crab is hunted ruthlessly and exterminated.

War of extermination had therefore to be declared on our farm. Before actually declaring war, I made inquiries from the entomologists and agriculturists for information in regard to the crab and means for its extermination. From time to time I received suggestions. The first one that seemed reasonable came from the Agricultural Department who suggested the use of carbon disulphide. A teaspoonful had to be poured down the burrow, and the entrance plugged with wet clay. I tried this method for two seasons, with so little effect, and with so much cost, that I had to beat a strategic retreat. Later I tried blowing cyanogas into the burrows and sealing them off. This was no more successful. I carried my inquiry to chemical manufacturers. I was offered profuse advice, and told in turn to use lead arsenate, D.D.T., Cymag, Folidol and a number of other patent preparations, one as unsuccessful as the other. By none of these methods and preparations could I succeed in killing more than a hundred crabs in a season on my farm. I felt frustrated and helpless. 'Could nothing rid me of this turbulent pest'? I started occasional attacks with sticks. This was much more effective than chemicals. I offered a reward to any one who would bring me 100 dead crabs. In a full season we counted 500 dead. Was this the best we could do? I started watching the movements and behaviour of the enemy. When and where are they most defenceless? There are two periods during the monsoon, when the greatest success can be achieved. The first is at the beginning of the monsoon. Coming out after their six or eight months of underground life, they are slow and hungry and in the case of females, loaded with young ones. There is very little of grass and weeds, and they have to wander far from their burrows to forage for food. As soon as nallahs begin to flow, they swarm in, and will not run away in a hurry. Now is the opportunity to use the big stick. Within the space of an hour, you may destroy a hundred and more over a hundred-foot stretch. Unfortunately in this slaughter many babies get away from their mothers' abdomens. Such a period of weak defence may last one to three weeks, depending on the rainfall.

The second period for a wholesale slaughter is in September when the young ones have become sufficiently visible and have dug their independent holes. Such holes along the banks of nallahs are shallow, and by a light digging you can expose the crab. At this time too, a hundred crabs may be easily accounted for within a space of a hundred feet.

After the early monsoon slaughter, the crabs' defence is much more effective. They do not stray far from their burrows and their quickness, keen eyesight and vigilance, enable them to retreat into their holes at sight of the hunter. Now it is no more possible to bludgeon the beast, and a new technique must be adopted. I used an airgun fairly successfully; one had to shoot from about 15 to 20 ft.'s distance. I also started using an 8 to 9 ft.-long hollow bamboo. With this I started harpooning the crabs. The crabs became more and more wary; still I was quite successful. My technique developed in another direction. Instead of striking directly at the crab, I first decided which hole the crab belonged to, and thrust the bamboo in such a manner as to block the entrance. I was either able to score a direct hit as the crab was retreating, or I prevented it getting into its hole, thus enabling me to attack it with my foot. This method gave me a fraction of a second extra time and increased the chance of a kill. Thus, in results it made a big difference. In certain positions when I had to use the harpooning method from a long distance on the flat, or if I had to attack down a bank, it was not possible to block the hole; here it was best to give the crab a smart push across the hole, and in doing so, one either kills the crab outright, or pushes it sufficiently far from its hole for a second and a third attack.

Approaching the enemy is a skilful job. In a few days the crabs within an area began to recognise me as their Enemy No. 1, and then approach had to be very wary, and varied. The quarry spots us from a distance of quite 60 ft., and rushes into its burrow before any form of attack becomes possible. If in approaching, you can keep a bush, a tree or even tuft of tall grass in between, you can get to within 10 ft. which is a striking distance. A quick rush gets the crab flurried, and through fright he loses his bearing in relation to his burrow, and is then done for. He runs here and there and provides a good opportunity for us to strike. As usually there are several crabs within a short distance of each other, one often makes the mistake of shifting the eye from the chosen quarry when approaching. This is fatal; we lose all. The eye must be inexorably fixed on one only, and all attention concentrated on that one.

In planning an attack, the senses possessed by the crabs and their normal behaviour require to be studied, as one may well imagine. Sight is extremely keen, and their wandering eyes seem able to see things in all directions at one and the same time. On the flat, even at a distance of sixty feet, the crab recognises his enemy, and nearer approach becomes difficult. With this keen eyesight there is distinct evidence of a working mind. I have noticed that if a crab is on the opposite bank of a nallah, and I start to walk round to its side by a circuitous route, the crab invariably disappears. He evidently decided I was coming round to attack him. The crab's sense of smell is utilized by the villagers for catching him with a bait of fish or meat. Can the crab hear? I feel certain he does. Often have I noticed that as soon as I tread on twigs and make a crackling sound, the enemy disappears. It is common knowledge that if you approach a crab by night with a lantern or a torch, he does not run away easily. Does the light blind him, or is he paralysed with fear? Or does his natural instinct of safety at night make him unable to think differently even in the presence of evidence to the contrary? One sees villagers making use of this failing for catching crabs.

Crabs often have more than one entrance to their burrows. Possibly this is one of their defence tactics. If one entrance is blocked, or an enemy enters through one, they can escape through the other.

With my way of attack, two entrances which are often within a few inches of one another, are a disadvantage: as soon as I see the crab entering through one, I thrust my stick deep into the other. I thus block the passage to the depths: then I press my stick towards the other entrance; that passage gets narrower and finally the crab is forced to rush out. This gives me the opportunity to attack by foot.

What did I achieve by all these methods of destruction? To gauge this, I must inform you that my farm is 5½ acres of which one acre is occupied by buildings, roads, stables, wells etc., and the area where crabs could live, would be just over four acres. Active, organised warfare against crabs by my methods was started here in 1951. On this area of four acres I was able to account for 3,000 crabs in the first year, 1,000 in the second year, 800 in the third and 600 in the fourth year. Considering that as time passed, I was developing more and more skill and ingenuity, the fall in the number of kills shows how definitely the crab population has been reduced. I may well claim that I have checked and controlled the crab menace on my farm. Now, even in the monsoon my seedlings have a good chance of survival. The number of crabs I spot on my rounds, has fallen to a fraction.

This brings me to the question of density of crab population in the Konkan. I have repeatedly counted the number of burrows per 100 sq. ft. on my land, and I estimated the density in 1950 as 1,500 to the acre. At the end of the 1954 season, my estimate for my farm is 200 per acre. Fifteen hundred crabs let loose in the midst of an acre of seedlings will do an enormous amount of damage, and they do. Even the 200 are 199 too many, and we hope to see the 199 wiped out. Can we expect a 100% success? No. Crabs spread from neighbouring areas and many are carried to us by the rushing waters of nallahs. I feel confident however that with energy and vigilance, numbers can be kept down sufficiently low to allow cultivation to be carried on profitably and with safety.

A few points in regard to crabs are interesting. What age do they live to normally? I would state unhesitatingly that the normal life is three years. In the first season the young ones grow to half size; next season they complete their growth; in the third they produce their young in June and die before the end of the monsoon. In the second season crabs mate in September, incubate during their underground existence, and the mothers emerge next June loaded with young.

The food of crabs is mostly vegetarian, specially young seedlings of all kinds. They do eat fish, meat and insects also, but this a very minor part of their food. I have very rarely seen animal food in the jaws of a crab.

That crabs must have enemies, parasites and diseases may be taken for granted. From my observations, I would not say that the crab is surrounded by enemies. Man is certainly Enemy No. 1. Although I have seen kites and toads capturing crabs, this is not a very common occurrence. During the last five years, I have spent about 500 hours, chasing crabs, but have only twice spotted a kite carrying off a crab, and similarly on two occasions I have seen a toad with a crab in its mouth. As, however, I see many crab holes in October, occupied by toads, I take it that toads do hunt the crab.

I do not claim that my method of crab destruction could be practical on large farms, except as supplementing attack by poisons. The farms in our country generally are quite small and I am convinced that if the cultivators are zealous in hunting down this pest, they will be able to achieve sufficient success and security to surmount the risk to and destruction of their monsoon seedlings.

CHEMBUR,
BOMBAY,
January 4, 1955.

JABIR A. ALI,
B.A. (Cantab.), C.D., AG.

24. *APUS* (CRUSTACEA: PHYLLOPODA), A NEW HOST FOR PARASITIC NEMATODES[1]

While examining a sample of *Apus orientalis* Tiwari from Panchgani, very obligingly made over to me by Shri Humayun Abdulali of the Bombay Natural History Society, I came across two specimens of what looked like larval stages of some nematode. The specimens were lying coiled up in the digestive tract in the abdominal region of the host.

The number of crustacean interhosts of parasitic nematodes from India is very small Bayliss[2] has listed the following crustaceans acting as interhosts for larval stages of nematodes recorded from India (before partition), Burma and Ceylon.

NAME OF THE HOST	PARASITE
Uca manii (Crab)	*Rhabdochona uca*
'Prawn' (Macrura)	*?Eustrongyloides* sp. (larva)
Cyclops hyalinus (Copepoda)	*Dracunculus medinensis* (larva) *Camalus sweetei* (larva)
Cyclops leuckarti (Copepoda)	*Dracunculus medinensis* (larva) *Camalus sweetei* (larva) *Camallanus* sp. (larva)
Cyclops vermifer (Copepoda)	*Dracunculus medinensis* (larva)
Cyclops sp. (Copepoda)	*Gnathostoma spinigerum* (larva)

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[1] Published with the permission of the Director, Zoological Survey of India.

[2] Bayliss, H. A. (1939): Faun. Brit. India; Nematoda, **2**.

Besides the above, the only record of crustacean hosts of nematodes, that I have come across, is by Lindberg[1, 2] and all of them are cyclopoid copepods. Even in Bayliss' list, barring the first two (a crab and a prawn), the other four species belong to cyclopoid copepods.

The occurrence of larval stage of a nematode in the digestive tract of *Apus orientalis* is, therefore, of unusual interest. This constitutes, as far as my knowledge goes, the first record of a nematode parasite from a phyllopod crustacean from India, and *Apus* as a nematode host would probably figure for the first time in the world. It would be interesting if some more conveniently situated worker would look into the incidence of infection in *A. orientalis*, which is very common in pools on the Tableland at Panchgani, and establish the identity of the parasite.

ZOOLOGICAL SURVEY OF INDIA,
34, CHITTARANJAN AVENUE, K. K. TIWARI
CALCUTTA 12,
December 4, 1954.

25. AN UNUSUAL CRAB FISHERY IN THE SEA OFF ENNUR, NEAR MADRAS[3]

(*With a text-figure*)

There are regular crab fisheries in the Gulf of Manaar and the west coast of Madras State. But such fisheries are rare along the east coast, only a few *Neptunus pelagicus* and *N. sanguinolentus* being obtained accidentally in the 'thurivalai', the commonly used boat-seine net. In the backwaters, however, hoop-nets are employed for the capture of the Green Crab, *Scylla serrata*.

An unusual fishery of *Neptunus sanguinolentus* occurred along a one-mile stretch of Ennur coast in the second week of August, 1954. Swarming of these crabs close to the shore commenced in the early hours of 8th August and lasted for four days. The local fishermen took advantage of this phenomenon, and employed several hoop-nets (locally known as 'nandukatcha') either by wading or by using small catamarans in the shallow waters within a limit of one furlong from the shore; and captured a record number of 20,000 crabs.

The 'nandukatcha' is similar to the prototype hoop-net of Europe. The local form consists of an iron ring (16-24 inches in diameter) from which is suspended a shallow conical bag-net with meshes varying from 0.5 to 3.0 inches. Across the ring, baits are tied with strings or iron wire, which cross each other. The baits used are

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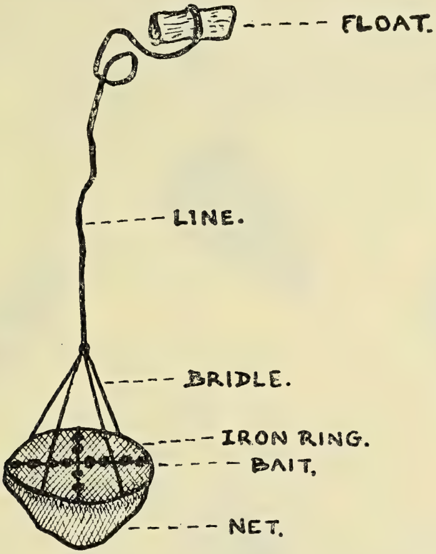
[1, 2] Lindberg, K. (1946): *Bull. Soc. Pathol. escot. Paris*, **39**: 303-318 and 318-328.

[3] Published with the permission of the Director of Industries and Commerce, Madras.

pieces of crustaceans like *Hippa* and *Albunea*, and of fishes like skates, eels and soles. The nets are provided with 3 or 4 bridles (15 inches in length), which are joined together to a long line tied to a wooden float. The length of the line varies with the depth of water at the place of operation. The floats help not only to indicate the position of the submerged net, but also to keep the latter steady. About 5-6 such hoop-nets are laid down simultaneously by a single fisherman, who lifts them up from the water at regular intervals and transfers the crabs that gather around the bait into his basket. In this way a fisherman obtained about 200-300 crabs in a day during present fishery.



NANDU KACHA.

A feature of the fishery was that nearly 90 per cent of the catches was gravid females with their eggs in various developmental stages. The length and width of carapace of the individual crabs ranged from 95 to 140 mm. and 45 to 65 mm. respectively; and their weight varied from 61 to 150 gms. The fact that almost the entire population was of berried females throws light upon the breeding migration of these decapods for the purpose of propagation in a new surrounding. Though the fishermen were jubilant over their unusual harvest they were unaware of the depletion they caused in the crab fisheries. However, the balance of Nature is maintained by the survival of the offsprings of the few crabs that escape from the fishermen.

Fisheries Biological Station,
Ennur, near Madras,
November 22, 1954.

P. I. CHACKO
E. PALANI

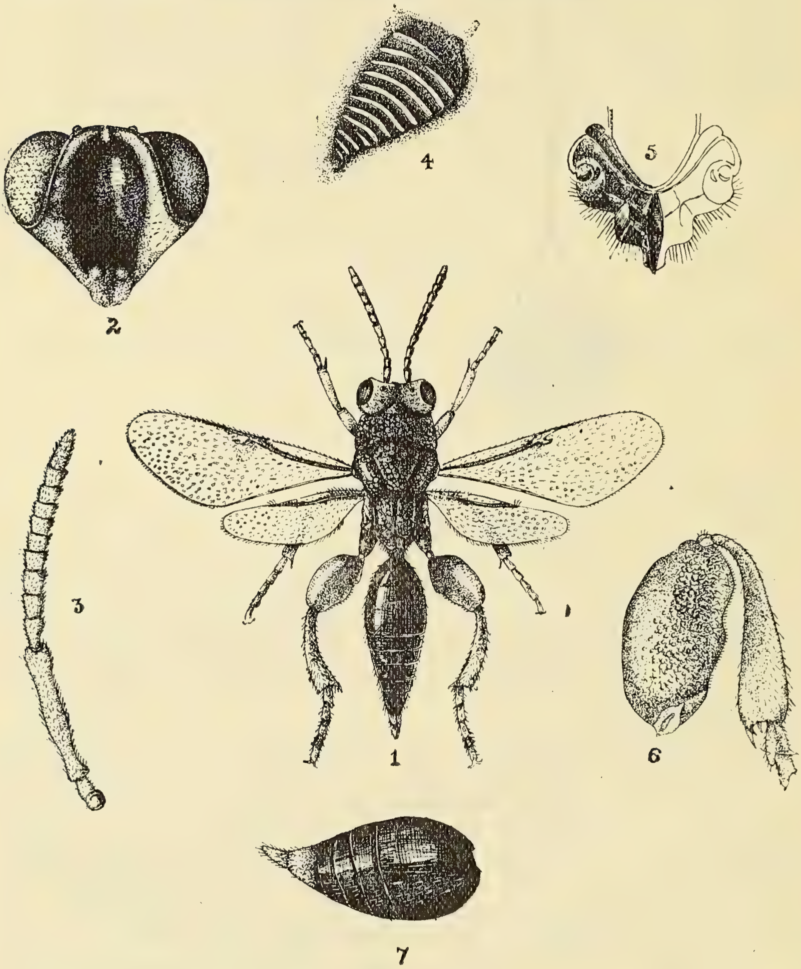
26. A NEW SPECIES OF *ANTROCEPHALUS* KIRBY

(*With a text-figure*)

During September, 1953, the author was asked to undertake a survey of pests damaging apple orchards in the Kotgarh area in the Simla ranges. While examining a bee-hive which was highly infested with the Wax Moth, *Galleria mellonella* L., he came across this parasite. The following is the description of the new species.

Antrocephalus galleriae new species

Super family Chalcidoidea, Family Chalcididae.



1. *Antrocephalus galleriae* new species ×6.
2. Head; Front view showing the scrobes and position of ocelli.
3. Antenna.
4. Mesofemoral impression.
5. Posterior margin of propodeum.
6. Hind leg.
7. Abdomen, side view.

Female. Black. Length 7.5 mm. Fore legs dark brown. Hind legs; coxae black; femora externally blackish, more castaneous only round the edges; hind tibia castaneous only distally; tarsi castaneous. Fore wings hyaline.

Head. Head in front view appears triangular: Breadth 2 mm. Length 2.25 mm., in profile narrow. Scrobes very wide and deep, extending to the orbits, before each of which is an elevated carina that descends down and ends on the malar keel. Vertex rugose, covered with white short pubescence. The anterior ocellus within the scrobe. Lateral ocelli on the vertex slightly away from the orbits. Antenna length 3.25 mm.; dark brown; club castaneous. Scape length 1.125 mm., elongate, slender; near the base 0.1 mm. broad, near the apex 0.125 mm. Pedicel slender, a little over 1/5th of the scape. Funicle 8 jointed, all cylindrical though segments 2 to 6 are broader than the preceding one. Segments 7 and 8 narrower than the 6. Club is longer than any of the funicular segments; shows only one false suture.

Thorax. The entire notal surface is densely set with thimble-like punctures; the surface between the punctures being minutely rugose. Each puncture gives rise to a minute glistening white bristle. Pronotum anteriorly margined; antero-medianly descending down vertically. Scutellum extending far back; two distinct teeth on the posterior margin; longitudinal median depression present. Mesopleural femoral impression has 12 ridges of which two are incomplete (see fig. 4). On the ventral side of the metapleuron the glistening white pubescence is dense.

Propodeum. The propodeum is highly sculptured. The pattern exhibited on the posterior margin of the propodeum is shown in the figure. On the ventro-lateral sides there is a thick growth of white long glistening hairs. As shown in the figure the shape and pattern of the sculpturing of the propodeum is entirely different from the described species of the genus.

Wings. Fore wings triangular, not quite three times as long as broad. Length 4.25 mm., breadth 1.6 mm. Submarginal, marginal and postmarginal exactly in ratio of 7:2:2. Hind wing length 3.25 mm; breadth 0.95 mm. A brownish spot is present from the uprise of the marginal vein to the club of the radius and its maximum breadth being more than twice the length of the radius.

Legs. Hind femur with two inner lobes on the ventral ridge which are dentate; about 54 in number. The dentition starts from the apex and ends at less than 1/3 of the length of the femur from base. Tibia with two short peg-like spurs, the inner being 0.4 mm. in length, and the outer 0.6 mm.

Abdomen. Tergites shining black, devoid of pubescence on the dorsum. Regular rows of long white bristles on the sides.

Holotype. Female partly dissected and mounted on celluloid strip; wings, antenna and hind leg mounted on a slide in Canada balsam. Labelled: Locality—Madhuban Orchards, Thanedar, Simla ranges, Himachal Pradesh. 'From the hive of *Apis indica* F.' Coll. B. R. Subba Rao. 2-9-1953. Deposited in the National Pusa Collection, Indian Agricultural Research Institute, New Delhi.

Remarks. Since it was collected from a hive which was highly infested with the Wax Moth, *Galleria mellonella* L., it is quite probable that the species recorded is a parasite on the wax moth larvae. However, literature shows that this genus is mainly parasitic on the teak defoliating Lepidoptera caterpillars in India.

Antrocephalus galleriae is very near to *A. renalis* Waterst., but differs from the latter in possessing the following characters: Wings hyaline; tarsi and club of antennae castaneous. Marginal and postmarginal veins equal in length. Brownish spot more than twice broader than the length of the radius. Of all the species of *Antrocephalus* recorded from India only *A. galleriae* is 7.5 mm. in length which is the longest on record. *A. renalis* comes next with length 6 mm.

I am grateful to Dr. E. S. Narayanan, Head of the Division of Entomology, for going through the paper and offering suggestions. My grateful thanks are also due to Dr. M. S. Mani, Professor of Zoology and Entomology, St. John's College, Agra, for confirming my identification and for his valuable suggestions.

DIVISION OF ENTOMOLOGY,
INDIAN AGRICULTURAL RESEARCH INSTITUTE,
NEW DELHI,
January 8, 1955.

B. R. SUBBA RAO,
B.SC. (Hons.), Assoc. I.A.R.I.

27. SOME INSECTS ATTRACTED TO LIGHT—II

This is a further list of insects attracted to light in addition to those already reported by me [*JBNHS*, 52 (2 & 3): 647-650]. The collections were made in Bangalore during November 1953 unless otherwise indicated. Most of the species included here were determined by the authorities of the Commonwealth Institute of Entomology, British Museum (Natural History), London, and my thanks are due to them. I am also grateful to Dr. M. PuttaRudriah, Government Entomologist, for facilities.

LIST OF INSECTS

ORTHOPTERA

Tetrigidae.—*Criotettix grandis* (Hanc.) (October), *Hedotettix costatus* Hanc. (July), and *Hyboella latifrons* B. (May).

Gryllidae.—*Trigonidium humbertianum* S.

DERMAPTERA

Forficulidae.—*Diplatys sinuatus* Hincks.[1]

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[1] A new species, the description of which will shortly appear in W. D. Hinck's Catalogue of the Dermaptera of the British Museum, Vol. I.

ISOPTERA

Termitidae.—*Odontotermes obesus* (Ramb.).

EMBIOPTERA

Embiidae.—*Oligotoma saundersi* Westw.

HEMIPTERA

Delphacidae.—*Delphacodes propinqua* Fieb. (December), and *Perigrinus maidis* Ashm.

LEPIDOPTERA

Pyralidae.—*Phycita* sp.

Bombycidae.—*Trilocha ficicola* Westw.

Geometridae.—*Scopula cleoraria* Wlk.

Agrotidae.—*Acantholipes circumdata* Wlk., *A. circumflueta* Wlk., *Gesonia obeditalis* Wlk. and *Ozarba* sp. nr. *lepida* Saalm.

COLEOPTERA

Elateridae.—*Cardiophorus notatus* Olv. (May).

Curculionidae.—*Myllocerus cardoni* Mshll. (August).

Geotrupidae.—*Bolboceras quadridens* F. (August).

Aphodiidae.—*Aphodius reichei* Har.

HYMENOPTERA

Bracondiae.—*Heterogamus* sp. nr. *percurrens* Lyll.

DIVISION OF ENTOMOLOGY,
DEPARTMENT OF AGRICULTURE,
BANGALORE,
December 28, 1954.

S. USMAN

28. NOTES ON *THRIPS PALMI* KARNY, ATTACKING *SESAMUM INDICUM*

(*With a plate and a text-figure*)

Ramakrishna and Margabandhu (1939) have recorded *Thrips gossypicola* Priesner from Coimbatore and the author has also noted *Tryphactothrips rutherfordi* Bagnall, on sesamum plants, without any injurious effects. Quite recently the author came across a localised group of sesamum plants in Madras badly attacked by *Thrips palmi* Karny, which ultimately resulted in the malformation of the stamens, injury to the ovarian wall and ultimately the development of a dark pigment on the fruit wall, instead of the usual green colour.

Previous records of *Thrips palmi* Karny, in India, show that they have been recorded on tobacco, lablab flowers and lantana flowers, with no special effects of injury.

Adult female: It is pale yellow and is characterised by 'third antennal joint about as long as the sixth; head shorter than pronotum; upper vein of forewing distally with three setae; lower vein 11-13; costa with 20-22 setae'. Total length of female 1.16 mm. (average).

Males: The males are smaller than the females and have 'abdominal sternites without pale depressed areas; costa with 20-22 setae. The four long setae on the 9th tergite equidistant from each other.' Total length of male 0.91 mm. (average).

On an average, in each flower were found 4-8 adults and 8-20 larvae. Oviposition is between the anther lobes of the stamens at their free ends, the eggs being small, oval, yellowish white, measuring on an average, 0.238 mm. long and 0.196 mm. broad at middle.

Larval Stages: The first instar larva is about 0.58 mm. long and is pale yellow in colour with the body segments almost clearly defined. The maxillary palps are distinct 3-jointed, but reduced in size. The antenna is 100 μ in length. The last abdominal segment bears dorsally a pair and laterally two pairs of well-defined and long bristles. Anal bristles are moderately long, measuring 100 μ.

The second instar larva is much longer and is about 0.8 mm. long. The bristles on the thoracic and abdominal segments are more conspicuous. The maxillary palps are well defined with basal joint the shortest and the stoutest and the distal one longest and thinnest. The antenna is distinctly 7-jointed and 116 μ long.

Effects of injury: The stamens were observed to be completely malformed and are as represented in the figure. The larvae were observed to congregate round the base of the corolla tube, feeding on the walls of the ovary. As a result of the constant punctures made by the stylets, the walls of the ovary showed a number of dark patches. The general epidermis of the fruits which are green in normal ones, develops black pigment.

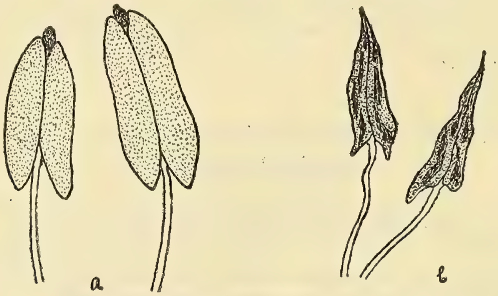


FIG. 2. (*a*) Normal stamens with egg between anther lobes.
(*b*) Malformed stamens.

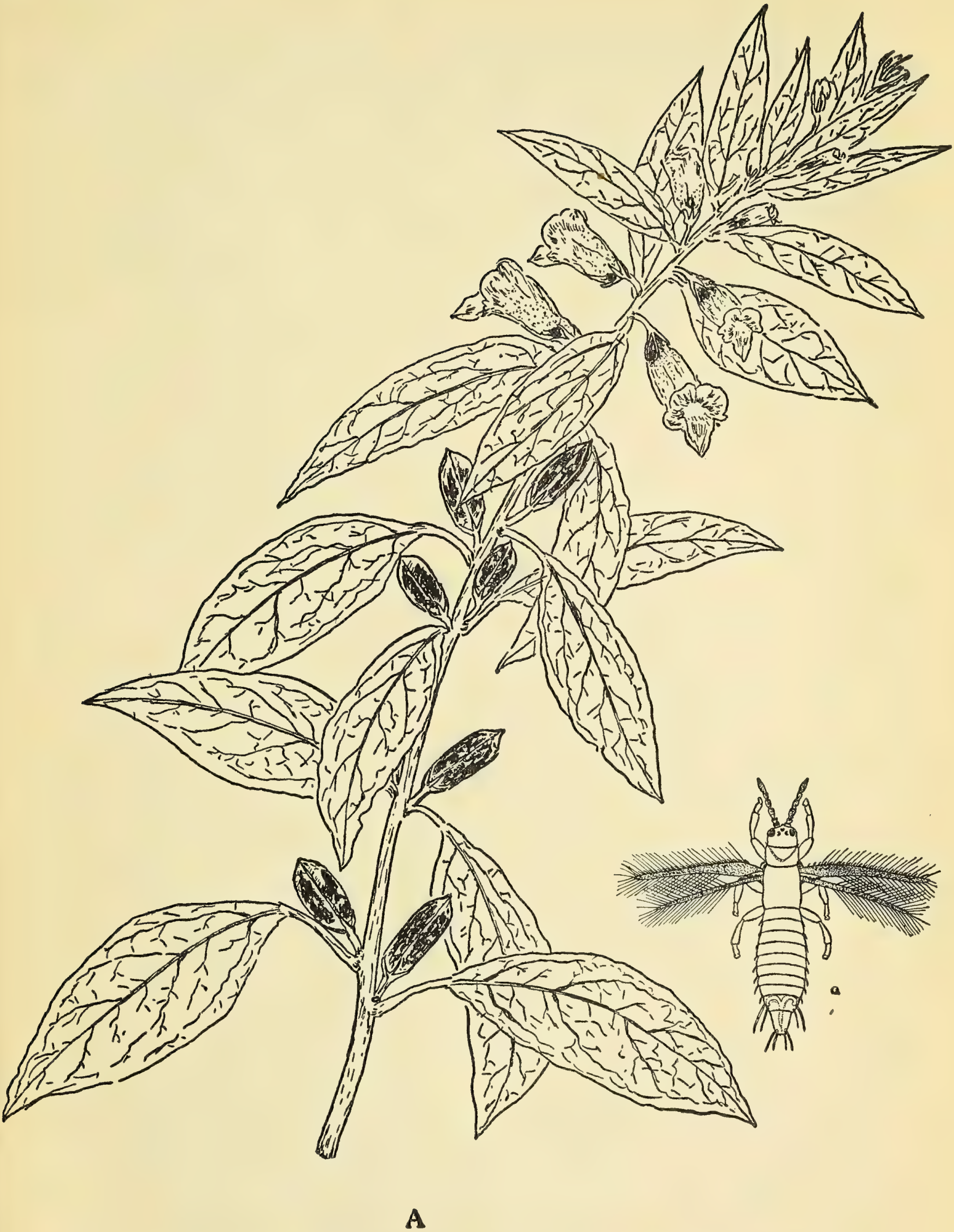


Fig. 1. A.—Attacked sesamum plant showing fruits with dark pigment.
a.—*Thrips palmi*, female.

The following conditions of temperature and humidity in which the plants concerned have thrived, might prove useful for future observations on the incidence of this Thrips.

Month	Temperature in F.		Mean humidity	Total rainfall in inches
	Max.	Min.		
June 1953 ...	99·1	82·8	55	0·37″
July ,, ...	95·3	79·4	63	3·38″
August ,, ...	95·0	79·7	63	2·62″
Sept.	91·6	77·8	75	5·08″

LOYOLA COLLEGE,
MADRAS 6,
November 20, 1954.

T. N. ANANTHAKRISHNAN,
B.SC. (Hons.), F.Z.S., F.R.E.S.

29. APOSEMATIC INSECTS AND THEIR FOOD-PLANTS

There is a French proverb to the effect that tastes and colours should not be argued about, which might be extended to cover scents; nevertheless I propose to continue the present discussion.

I cannot help feeling that Mr. McCann's example of *Aularches* is well suited to disprove Haase's theory that aposematic insects (he was considering Lepidoptera chiefly) derive protection from the poisonous qualities of their larval food-plants. Here we have an Orthopteron, aposematic in both its nymphal and imaginal stages, feeding on, and smelling of, a different poisonous food-plant in each stage. In other words the smell of the nymphal food-plant does not survive the very minor metabolic disturbance involved in the transition from nymph to imago. What chance, then, would it have of surviving the tremendous metabolic upheaval that occurs between the lepidopterous larval and imaginal stages?

There can be no doubt that the greater part of an insect's constituents are derived from its food, but I believe that this is through an indirect process of analysis and synthesis, and not by direct absorption. There are far too many procryptic insects feeding on poisonous food-plants and aposematic ones on non-poisonous for direct absorption to be the only source of protection. Another point against Haase's theory is the number of insects with similar scents and widely different food-plants and vice versa. I would also again like to stress the non-poisonous Passifloraceae, which, so far as I know, provides the food-plants of all the Indian *Cethosia* spp. and the South American Heliconinae, as well as the food-plants of many of the Acraeidae, all most successful aposematic groups.

Mr. McCann has, I am afraid, missed the point of the Poulton reference. *Biston betularia* is a Geometer with a highly procryptic stick-like caterpillar, which has a pronounced capacity of producing colours harmonising with its surroundings, in nature it may be green or brown or mottled, and under experimental conditions a pale grey form has been produced by mixing spills of white paper amongst the twigs of the food. It has been used extensively in experiments to determine the value of procrypsis and is evidently, when feeding on its usual food-plants—hazel, birch, sallow, rose, etc.—highly palatable. It was this fact that made the rejection of the ivy-feeding larvae by hens, as Mr. McCann points out somewhat indiscriminate feeders, the more remarkable.

KAMPALA, D. G. SEVASTOPULO,
UGANDA, F.R.E.S.
September 22, 1954.

30. A FOUR-LEAVED OLEANDER

Nerium odorum (Marathi: Kanher, Gujarati: Karan) is described as having cyclic phyllotaxis with three leaves at each node. Each branch gives rise to three shoots at the top with a three-sided flowering branch in the centre.

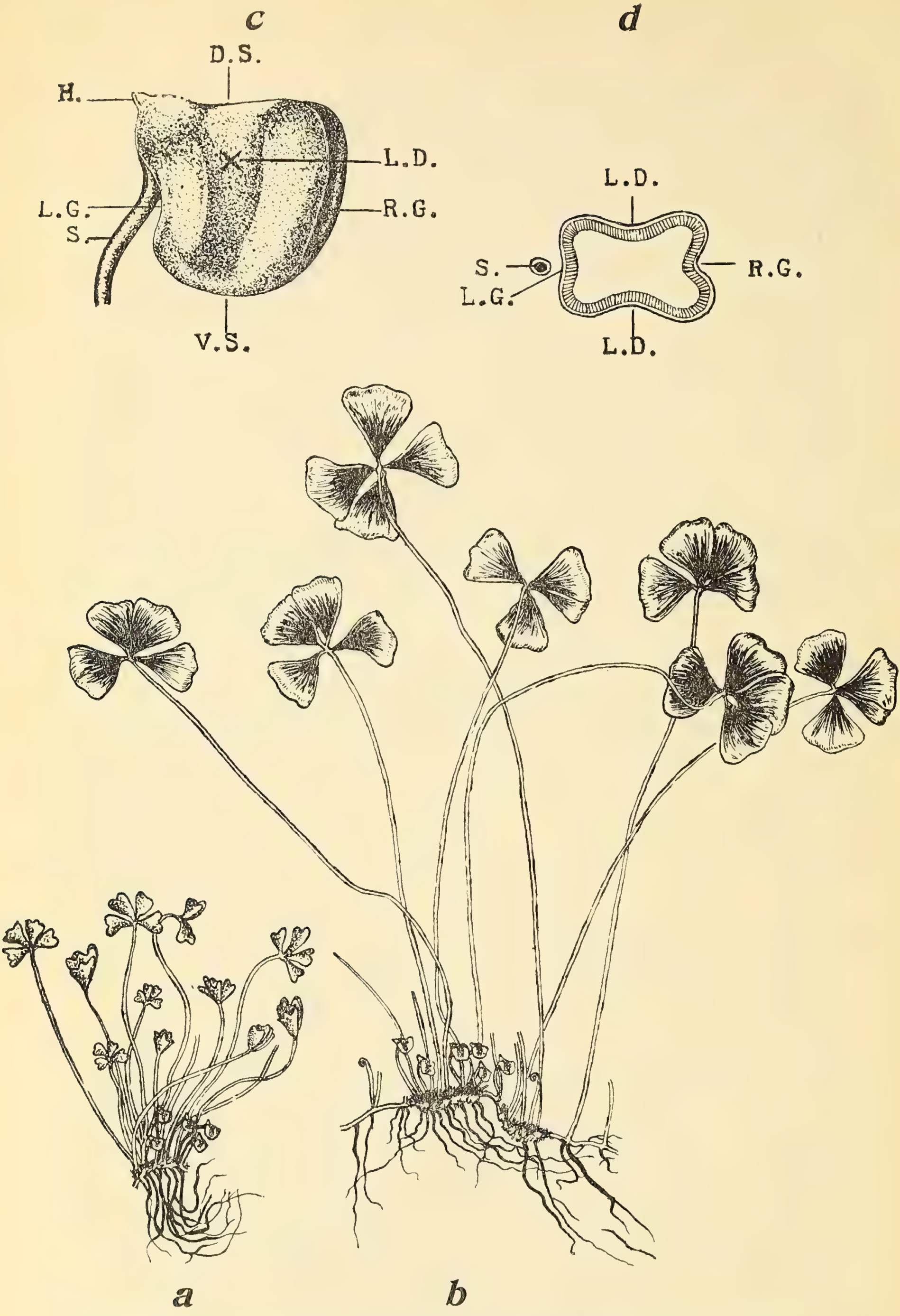
A red-flowered *Nerium odorum* in my garden has a branch with four leaves at each node. Four shoots came out at the top of this branch with a four-sided flowering branch in the centre. The flowering branch came off in the usual manner after the opening of the flowers on it.

'SANJEEVAN',
ELLIS BRIDGE, G. W. DEODHAR,
AHMEDABAD 6, B.A., M.SC.
September 27, 1954.

31. ON THE OCCURRENCE OF *MARSILEA AEGYPTIACA* WILLD. IN JODHPUR, RAJASTHAN (INDIA)

(*With a plate*)

The water fern *Marsilea* is a cosmopolitan genus found both in the temperate and tropical climate. There are sixty or more species occurring all over the world. After a revision of the genus by A. Braun in 1870 and which formed the basis of Baker's treatment in his 'Handbook of the Fern Allies' in 1887, no detailed description of its geographical distribution or systematics seems to have been attempted. The latest work is by Carl Christensen who described sixty-six species in his 'Index Filicum' (1906, 1913 and 1934). G. M. Smith, however, mentions only fifty-six species in his book 'Cryptogamic Botany' Vol. II, p. 327, 1938. There is no doubt, however, that a number of papers have been published on the morphological and physiological aspects of *Marsilea* by American and other workers in recent years, for example see *Annals of Botany*, Vol. 17, Nos. 62 to 67, 1952 and 1953; *Phytomorphology*, Vol. 3,



TEXT FIG. 1 *a, b, c, d.—Marsilea aegyptiaca* Willd. from Jodhpur, Rajasthan. (*a*) and (*b*) showing habit under sub-terrestrial conditions; (*c*) a single sporocarp (D.S.—dorsal suture, V.S.—ventral suture, R.G.—right groove, L.G.—left groove, L.D.—lateral depression, H.—horn, S.—stalk); (*d*) same in section (diagrammatic).

No. 3, 1953; *Bombay Univ. Journ.*, Vol. 5, 1937; Vol. 16, No. 27, 1948.

It is understood that there are eight species so far known from the Indian sub-continent, although their authenticity needs a careful checking. These are as follows:—

1. *Marsilea quadrifolia* L.
2. *M. minuta* L.
3. *M. brachypus* A. Br.
4. *M. gracilenta* A. Br.
5. *M. coromandelica* Burm.
6. *M. brachycarpa* A. Br.
7. *M. condensata* Baker.
8. *M. poonensis* Kohl.[1]

As a type of the Hydropterideae, *Marsilea* is prescribed for study in almost all Indian Universities and usually the material for practical work is collected locally. On transfer from Bikaner to Jodhpur, the author saw the local material in the practical class and suspected its identity with the common Indian species, or rather the common Rajasthan species, namely *Marsilea minuta*. A closer examination revealed the distinctive nature of the sporocarps in the Jodhpur material. A herbarium sheet was then prepared from a number of specimens of different sizes showing ecological variations. The plants for this purpose were personally collected from three or four different places situated within a radius of about eight miles in Jodhpur. The herbarium sheet was then sent to Kew for identification. The Jodhpur species was identified as *Marsilea aegyptiaca* Willd., a species previously recorded only from Lower Egypt and Astrakhan on the Caspian Sea. A detailed comparative study of the material has been entrusted to a post-graduate student in the department of Botany, Jaswant College, Jodhpur.

I have now examined a small sample of the original fertile material of *M. aegyptiaca* sent me by Sir E. J. Salisbury, Director, Roy. Bot. Gardens, Kew, and also some herbarium sheets of the sterile material from Prof. A. H. Montasir, Ibrahim University of Cairo. A habit sketch of fertile plants and a few dry herbarium sporocarps from Dr. K. P. Biswas, Indian Botanic Gardens, Calcutta, have also been examined by me. It is further proposed to examine in detail all the herbarium sheets of at least the Indian species at the earliest possible opportunity. I am convinced, however, that the Jodhpur material is undoubtedly identical with *M. aegyptiaca* and thus it is interesting to find the extension of the Egyptian species to Rajasthan, or the Rajasthan species going into Egypt and Astrakhan. An ecological and morphological investigation of the Jodhpur material is in hand as referred above. While this work progresses, more specimens from different places in India and abroad may be available for a comparative study of the plant. For the present it is sufficient to report the discovery of this new record in India and a welcome addition to the local flora of Jodhpur. I should like to add here that the material from many other places in Rajasthan so far supplied to me by friends has been found to be the common species *Marsilea minuta* or *M. quadrifolia.* It is, therefore, significant to note that this local species of *Marsilea* occurs almost like an endemic plant in Jodhpur flora; but I do not rule out the possibility of its presence in other places in Rajasthan or even beyond, specially because of two reasons: firstly the similarity between the present material and *M. condensata* Baker from Sindh (Pakistan) and my suspicion about some material from Ajmer. It can, however, be safely asserted that *Marsilea minuta* or any other known Indian species does not occur in the vicinity of Jodhpur.

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[1] It seems that necessary formalities required according to international rules for publishing an account of a new species were not gone through in describing this species.

This local species grows on land, muddy or even rocky banks of the local tanks as well as in shallow waters during the wet months. I am growing the plant quite successfully in flower pots and flower beds like other ferns, i.e. it grows excellently as a sub-terrestrial form. The size variations particularly in the length of rhizome and petioles are, as usual, clearly noticeable according to the prevalent climatic conditions (fig. 1: a, b). The sporocarps are quite distinct and compare with the Egyptian species in the following manner as pointed out by Mr. F. Ballard of the Kew Herbarium.

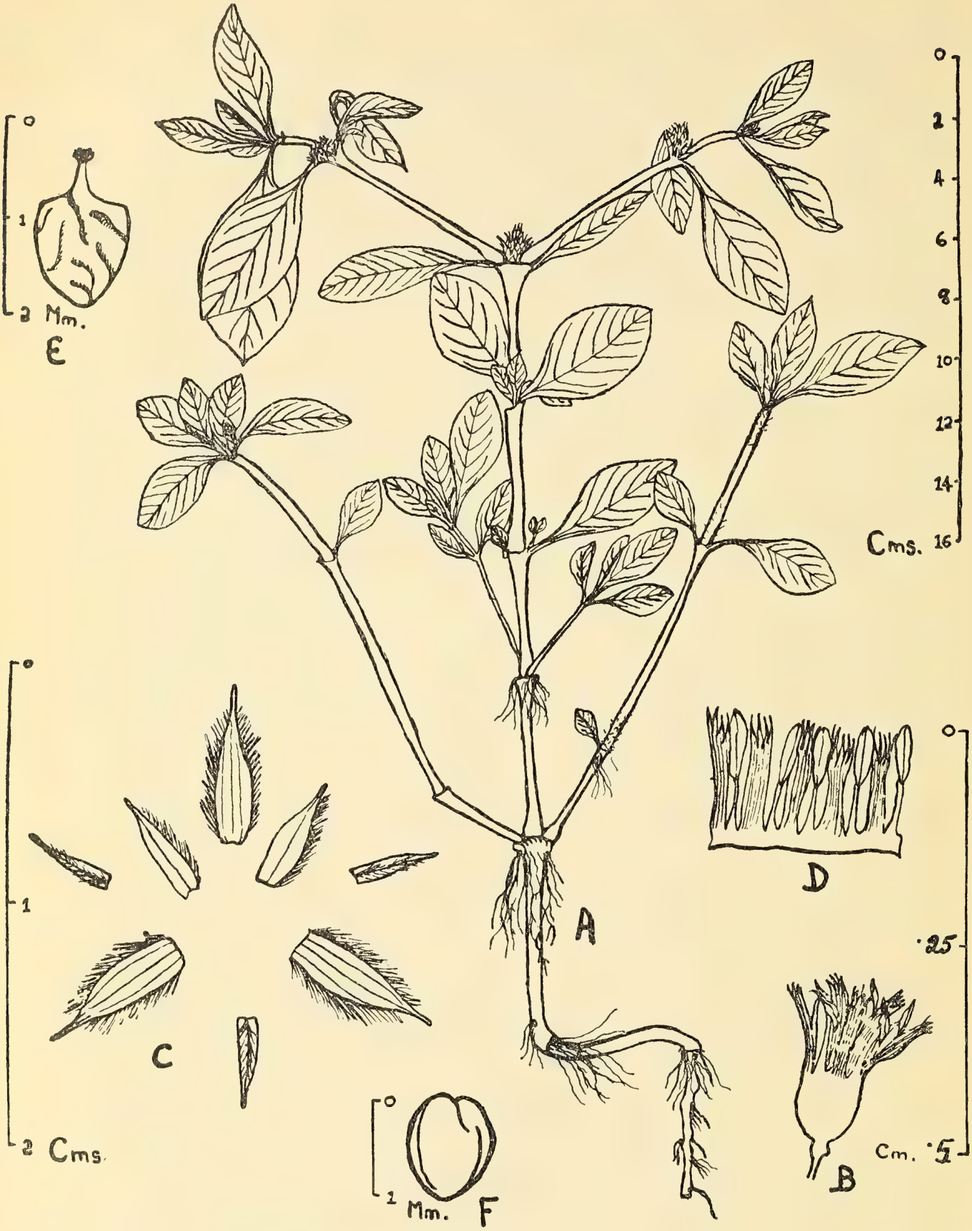
'1. The outline shape of the sporocarps is more or less square. 2. Only the upper tooth is preserved. 3. The sporocarps are borne solitary.' I may further add that the sporocarps are very distinctly grooved. The dorsal suture is marked by a ridge and the ventral one is more or less smooth. There are prominent depressions on the lateral sides whereas, the median planes are represented by a deep groove on the right and shallow depression on the left where the stalk of the sporocarps becomes fully adnate to its wall (fig. 1 : c, d).

Although marked variations are observed in the vegetative organs of the different species of *Marsilea*, the external and internal structure of the sporocarps must be considered as of superior diagnostic value to the vegetative organs. A sporocarp has been drawn here to show its external shape which is quite different from the common bean-shaped organs found in most of the other Indian species (fig. 1 : c, d). The preliminary examination clearly establishes its interesting and distinctive nature.

In the end I wish to express my grateful thanks to Sir E. J. Salisbury, Director, Royal Botanic Gardens, Kew, for his kindness and valuable help in getting the Rajasthan material examined so promptly at the Kew Herbarium by Mr. F. Ballard to whom my thanks are also due. I am also indebted to Dr. K. P. Biswas and Mr. R. S. Rao of Calcutta herbarium for their help in this connection.

BOTANY DEPARTMENT,
JASWANT COLLEGE,
JODHPUR,
November 11, 1954.

K. M. GUPTA,
D.SC.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14
16
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·25
Cm. ·5
B
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F

A. Whole plant.
B. An individual Flower.
C. The Perianth and Bracts.
D. The Staminal Structure.
E. Fruit.
F. Seed.

32. *ALTERNANTHERA POLYGONOIDES* R. BR., VAR. *ERECTA* MART.—A NEW RECORD FOR BOMBAY STATE

(*With a plate*)

In 1947 one of us collected a strange plant in the neighbourhood of Wadala Railway Station, Bombay Island; the specimen was obviously an *Alternanthera*, but we could not place it among the species described in any of our local or national floras; the specimen did not match with anything in Blatter Herbarium. The plant was sent to Kew for identification and through the kindness of Dr. N. L. Bor, was identified by Dr. K. Suessenguth of Munich as *Alternanthera polygonoides* R. Br. var. *erecta* Mart.

Recently the plant has been seen in great abundance by the roadside about one mile from Saki on the way to Vehar Lake, Bombay Island. Between 1947 and the present time the plant has been seen sporadically along the railway lines on Bombay and Salsette Islands; it has not been seen by any of us on the mainland of India.

This plant is American, probably Brazilian, in origin; how it came to be introduced into India, we have been unable to ascertain; it seems probable, however, that it was first introduced here during the Second World War years. It is now spreading slowly and gradually along the railway lines and main roads; to judge from the appearance of the plants seen in the field, one is justified in saying that Indian conditions suit the new arrival admirably; in a few years we may see the plant scattered through most of our country.

Stem herbaceous, erect or suberect, or often prostrate and rooting at the lower nodes, erect higher up, terete, glabrous or with two slender lines of hairs running vertically from node to node, smooth, somewhat swollen at the nodes and more or less hairy, slightly geniculate; the stem is generally green, but at times it is somewhat purple at the nodes. Leaves simple, entire, exstipulate, lanceolate to elliptic, acute or subacute at the apex, tapering into the petiole at the base, up to 8.5 x 3.5 cm., lamina glabrous or with a few scattered long hairs on both sides; nerves about 4-5 pairs, arching upward, obscure above, more prominent on the lower surface. Petioles up to 2 cm. long, but often obscure on account of the decurrent blade. Inflorescence, etc., very similar in most respects to *Alternanthera sessilis*.

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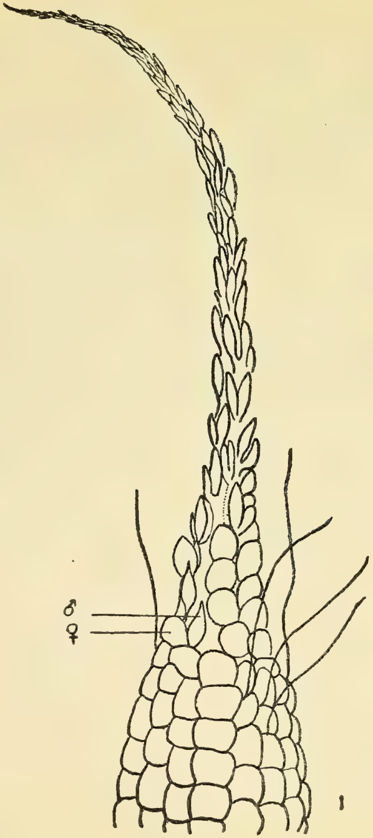
33. ABNORMALITIES IN THE 'EAR' OF *ZEA MAYS* L.

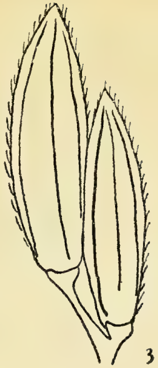
(*With a plate*)

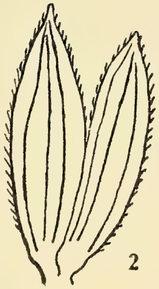
Two abnormal 'ears' with prominent terminal prolongations resembling the normal 'tassel' were seen in the maize crop grown this year. Although the occurrence of similar abnormalities in the 'ear' of *Zea mays* L. has been reported, detailed morphological studies of such abnormalities have not been made. The present paper therefore, is an attempt to describe the morphological details of these two abnormal 'ears' and the significance of their occurrence.

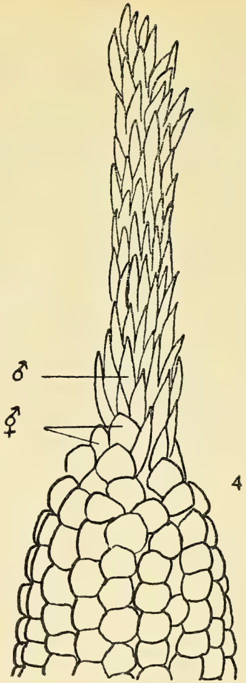
In one of the abnormal 'ears' (fig. 1) towards the basal end of the prolongation a male spikelet and a female flower were found to form pairs. Pairs of male spikelets or female flowers were also present in this region. In the middle region of the prolongation the male spikelets were arranged in pairs like the ones in a normal 'tassel'. The spikelets forming these pairs were equally short stalked and arose from the same level (fig. 2). One of the two spikelets forming a pair in a normal 'tassel', however, had a longer stalk than its partner (fig. 3). Both the spikelets of the pair arose from the same level in this case also. Each male spikelet from the abnormal 'ear' had two staminate flowers. Each staminate flower consisted of a lemma, a palet and three well-developed stamens, thus resembling the structure of the flower of a normal 'tassel'. The pollen grains from these staminate flowers also showed the same percentage of fertility (95-100) as that from a normal 'tassel'. The terminal end of the prolongation consisted of sterile undeveloped male-like flowers. In the other abnormal 'ear' (fig. 4) the prolongation was more prominent as larger number of male spikelets were aggregated on a comparatively short thick axis. All the male spikelets of this abnormal 'ear' were arranged in pairs and in all essential respects resembled the paired male spikelets of the first abnormal 'ear'. The terminal end of this prolongation, however, had fertile male spikelets. In addition to the male spikelets two bisexual flowers were present on this prolongation (figs. 4-6). The bisexual flowers had three stamens with 97.5 per cent pollen fertility. The number of leaves of the involucre covering the ovary of the bisexual flower was more than that of a normal female flower. The style of these two flowers was short and stout.

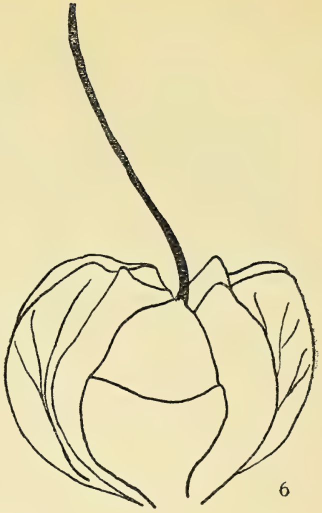
As the fertile male spikelets are situated on the terminal end of the abnormal 'ear' itself, there are better chances for selfing to occur in nature. Inbred seeds could be collected by simply bagging such abnormal 'ears'. Such abnormalities may, therefore, be of interest to a plant breeder. It may be mentioned here that well-developed 'grains' were present on these abnormal 'ears'. The occurrence of male and bisexual flowers on the 'ear' of *Zea mays* L. may also throw some light on the origin of 'ear' of this important crop plant.











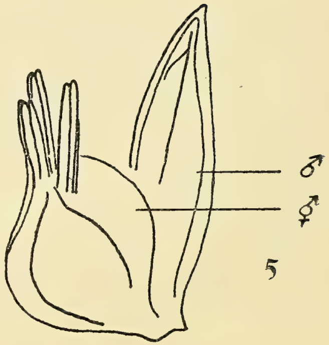


Fig. 1. Abnormal 'ear' with 'tassel'.
Fig. 2. Pair of male spikelets from the abnormal 'ear'.
Fig. 3. Pair of male spikelets from the 'tassel' of a normal plant.
Fig. 4. Abnormal 'ear' with 'tassel' and bearing two bisexual flowers.
Fig. 5. One of the bisexual flowers together with a male spikelet enlarged.
Fig. 6. Pistil of the bisexual flower with part of the involucre.

I am thankful to Miss Anna Sheila Chandi for helping me in the study of the material and the preparation of the figures.

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34. THE INTRODUCTION OF *TILAPIA MOSSAMBICA* INTO INDIA—A CORRECTION

With reference to the article 'Observations on *Tilapia mossambica* Peters in Madras', published in Vol. 52 (2 & 3) of the *Journal* (pp. 349-353), it has been brought to our notice that the fish *Tilapia mossambica* was first brought to India on August 7, 1952 from Bangkok, Thailand, by the Central Marine Fisheries Research Station, Mandapam (Ministry of Food and Agriculture, Government of India). This fact is published in a detailed account 'On the mouth-breeding cichild, *Tilapia mossambica* Peters in the *Indian Journal of Fisheries*, Vol. I, 1954. Therefore, the statement by P. I. Chacko and B. Krishnamurthy that 'the fish was first introduced into Madras from Ceylon on September 8, 1952' is incorrect.

January 18, 1955. EDITORS

35. GLEANINGS

1. *Acoustic orientation in Birds*

Among notices of Recent Literature in *Auk* for January 1954, p. 100 is the following:

Griffin, Donald R. 1943 Acoustic orientation in the Oil Bird, Steatornis. *Proc. Nat. Acad. Sci.*, 39: 884-893—Evidence to show that *Steatornis* 'guides its flight through dark caves by a type of acoustic orientation similar to that used by bats, but the oilbird employs for this purpose short pulses of sound that lie well within the frequency range of human hearing.'

2. *The Vegetable Milch Cow: A Remarkable Tropical Tree which yields Rich Milk*

One of the most remarkable tropical trees, the Cow Tree, was described in an illustrated article by Mr. Paul H. Allen, Director of the Fairchild Tropical Garden, Florida, in a recent issue of the U.S. magazine *Natural History*. Mr. Allen describes how he first saw a man making a gash in the trunk of one of these trees on a hillside not far from his home in Costa Rica. As he watched the milky fluid beginning to flow and saw that the man was obviously finding it refreshing, he carefully noted the appearance of the bark, leaf and fruit and questioned the man about it. The Cow Trees range from Costa Rica southward to Ecuador and across northern

South America, usually in areas of high rainfall. The trees are known to the local inhabitants by such diverse names as '*Vaco*' '*Lechero*' '*Mastate*' and '*Palo de Leche*'. Mr. Allen says that the earliest, and probably best, description of the tree is that of the great naturalist and explorer Humboldt (1769-1859), who saw it on the north coast of Venezuela. 'For many weeks,' he wrote, 'we have heard a great deal of a tree whose juice is a nourishing milk. The tree itself is called the Cow Tree, and we are assured that the Negroes on the farm, who are in the habit of drinking large quantities of this vegetable milk, consider it highly nutritive.' To obtain the milk from the tree, a number of gashes are made in the bark, and a leaf is then inserted at the bottom of the lower gash to act as a spout when the latex starts flowing. Mr. Allen says that in its original state the latex can hardly be distinguished from fresh cream, and it tastes like the real article in coffee. He adds: 'After some exposure to the air, the taste tends to become chalky and slightly bitter. Some of its detractors even say it then resembles milk of magnesia or whitewash. Within about twenty-four hours it solidifies in the tapping cuts to form a chicle-like substance. About two years ago I brought a pint of it to Palmar, and we found that it could be chilled, whipped and flavoured with sugar and vanilla extract to provide an acceptable substitute for whipped cream. We served it on pie to neighbours, and they did not realise that it was anything unusual. Animals, however, at least dogs and cats, will not touch it.'

—*The Illustrated London News*, March 20, 1954, p. 453

3. *Animal fights*

18th January 1831—A great number of elephants fought in pairs during the morning . . . . When the elephant fights were over, two rhinoceros were brought before us, and an amusing fight took place between them; they fought like pigs. The plain was covered by natives in thousands, on foot or on horseback. When rhinoceros grew fierce, they charged the crowd, and it was beautiful to see the mass of people flying before them . . . .

A fight was to have taken place between a country horse and two tigers, but Lady William Bentinck broke up the party and retired. I was anxious to see the animal, he is such a vicious beast; the other day he killed two tigers that were turned loose upon him.

Combats also took place between rams . . . .

From Wanderings of a Pilgrim in Search of the Picturesque (1822-1844) by Mrs. Parkes, *The Sahibs* by Hilton Brown; William Hodge & Co., Ltd. 1948.

NOTES AND NEWS

The Chandrakala Hora Memorial medal of the National Institute of Sciences of India has been awarded to Dr. S. B. Setna for his continuing outstanding services to the fishing industry of Bombay.

His introduction and popularisation of mechanised fishing craft among fishermen has resulted in a vast increase in Bombay's fish supply and incidentally in an appreciable improvement of the socio-economic condition of the fishermen.

* * * *

Rev. Fr. Santapau, S.J., has taken over charge as Chief Botanist of the newly resuscitated Botanical Survey of India whose offices are temporarily located in the Indian Museum, Calcutta.

* * * *

By a notification under the Sea Customs Act (VIII of 1878) the Government of India has prohibited the taking by sea or by land out of India of butterflies except when a consignment is accompanied by a certificate from the Honorary Secretary-General, Indian Board for Wild Life, 34, Chittaranjan Avenue, Calcutta, to the effect that the butterflies are being exported for scientific or educational purposes, or to a recognised private collector of butterflies.

* * * *

Miss A. J. Randeria, who was awarded part of the Society's natural history scholarship in 1952 to enable her to pursue her botanical field study, has completed her thesis for the University of Bombay on 'The Gamopetalous Phanerogams of Borivli National Park', and won high praise from her examiners.

They commend it as a laborious piece of work, executed with diligence and thoroughness, which will serve as a model for other field workers.

* * * *

The following extract from *Loris*, the Journal of Ceylon Wild Life for December 1954, is of interest:—

> 'M. Alwis, Game Ranger, charged two men, with having shot five hare in Ellapatuwa in the night with the aid of a flash light. U. Mudalihamy, the first accused, pleaded guilty and the charge against the second accused was withdrawn. Mudalihamy admitted three previous convictions and was sentenced to three months' rigorous imprisonment.'

ERRATA

Vol. 52(1), April 1954.

Miscellaneous Notes No. 8 and 10 (p. 207 and p. 210) are by Mr. M. Krishnan, Perunkulam House, Edward Elliot Road, Madras and *not*, as ascribed, by Mr. S. M. Krishnan, Government Training College, Mangalore. The error is regretted.

* * * *

Vol. 52 (2 & 3), December 1954.

The Intelligence of the Indian Elephant.
Page 591 line 19 from top, for 'scope' read 'score'.
,, 592 ,, 23 ,, for 'insect' read 'instinct'.
,, 594 ,, 4 ,, for 'secrete' read 'secret'.

AN APPEAL

Dr. Hugh B. Cott of Cambridge University wishes to ascertain :—

(1) The colour of the yolk of eggs of Indian birds (any species). Exact records of colour of yolk accompanied by matched colour, either from one of the standard colour charts (e.g., Ridgeway's or Horticultural Colour Chart) are desired. A hand-painted patch of the colour matching the yolk will do instead.

(2) The food eaten by Indian crocodiles of different sizes. In addition to the quantity taken, details of the food items such as molluscs, fish, amphibians, reptiles, birds or animals, are desired, together with the exact total length of the individuals from which obtained (snout to tail tip).

Communications may be sent to the Honorary Secretary, Bombay Natural History Society.

BIRDS OF SAURASHTRA—with additional notes on the birds of Kutch and Gujarat (33 coloured plates, 51 photographs and 16 maps). By R. S. Dharmakumarsinhji.

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EDITORS: SALIM ALI, AND H. SANTAPAU
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Contributors of scientific articles are requested to assist the editors by observing the following instructions:

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2. The MS should preferably be typed (double spacing) on one side of a sheet only, and the sheets properly numbered.

3. All scientific names, to be printed in italics, should be underlined. Both in zoological and in botanical references only the initial letter of the genus is capitalized. The specific and sub-specific names always begin with a small letter even if they refer to a person or a place, e.g. *Anthus hodgsoni hodgsoni* or *Streptopelia chinensis suratensis* or *Dimeria blatteri*.

4. Trinomials referring to subspecies should only be used where identification has been authentically established by comparison of specimens actually collected. In all other cases, or where identification is based merely on sight, binomials should be used.

5. Photographs for reproduction must be clear and show good contrast. Prints must be of a size not smaller than 3¼ × 2¼ inches (No. 2 Brownie) and on glossy glazed paper.

6. Text figures, line drawings and maps should be in Indian ink, preferably on Bristol board.

7. References to literature should be placed at the end of the paper, alphabetically arranged under author's name with the abridged titles of journals or periodicals underlined (italics), and titles of books *not* underlined (roman type), thus:

Roepke, W. (1949); The Genus Nyctemera Hübner. *Trans. ent. Soc. Lond.*, **100** (2): 47-70.

Prater, S. H. (1948); The Book of Indian Animals, Bombay.

Titles of papers should not be underlined.

8. Reference to literature in the text should be made by quoting the author's name and year of publication, thus: (Roepke, 1949).

9. *Synopsis*: As recommended by the Royal Society Scientific Information Conference (July 1948), the editors consider it desirable that each scientific paper be accompanied by a synopsis appearing at the beginning, immediately after the title. The synopsis should be factual. It should convey briefly the content of the paper; draw attention to all new information and to the author's main conclusions. It should also indicate newly observed facts, the method and conclusions of an experiment, and if possible the essential points of any new finding, theory or technique. It should be concise and normally not exceed 200 words.

When the synopsis is completed it should be carefully revised by the author to clarify obscurities, and further compressed wherever possible without detracting from its usefulness.

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